

apc

Aug 2018
Issue 457

YOUR EXPERT

GUIDE TO TODAY'S TECH



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GET ON TOP OF
YOUR GAME

8 x NBN-READY ROUTERS
WITH ADVANCED GAMING
FEATURES ON TEST:

CAN THEY REALLY HELP YOU
SMASH THE COMPETITION?

PROTECT
YOURSELF
FROM HACKERS
& SNOOPS

- SURF THE WEB SAFELY
- RECOVER FROM RANSOMWARE
- COMPLETELY ERASE UNWANTED FILES

PERFECT
PASSWORDS
MADE EASY

GET SET UP IN APC'S
FAVOURITE PASSWORD
MANAGER WITH OUR
COMPREHENSIVE TUTORIAL

DOES YOUR
ANDROID NEED
ANTIVIRUS?

IS YOUR PHONE'S BUILT-IN
PROTECTION REALLY
ENOUGH TO THWART
MOBILE THREATS?

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THE COMPLETE 2018 GUIDE TO SAFEGUARDING
ALL YOUR DEVICES & ONLINE ACCOUNTS

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- > CREATE A RASPBERRY PI MULTI-ROOM AUDIO SETUP
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LATEST PCs & TECH FULLY LABS TESTED

- > ASUS TUF GAMING LAPTOP: DESIGNED TO LAST LONGER
- > SAMSUNG STUPID-WIDE LCD: IT'S LIKE TWO SCREENS IN ONE
- > HP ENVY X2: THE ARM-BASED 2-IN-1 WITH FULL WINDOWS



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4G LTE

Vigor2862L Series

Mobile Internet Solution for Small-to-Medium Businesses

DrayTek
Aust & NZ
www.draytek.com.au

Multi-WAN router with 4G LTE SIM card slot (150/50Mbps), VDSL2/ADSL2+, Gigabit Ethernet WAN, IEEE 802.11ac (AC2000), SPI Firewall, and 32 x VPN tunnels including 16 x SSL-VPN tunnels

Vigor2862Lac **Vigor2862L**

Aust/NZ VDSL NBN Ready Ethernet WAN NBN Ready Ethernet WAN UFB Ready

SIM Card 32x VPN

LTE/4G Specification

LTE/4G category 4
150Mbps downstream and 50Mbps upstream
4G LTE FDD Band: 1, 3, 4, 5, 7, 8, 28
4G LTE TDD Band: 40
3G WCDMA Band: 1, 2, 5, 8

The LTE feature makes the Vigor2862L series router an ideal solution for applications such as:

- Provision of Internet access on public transport such as coaches, buses, trains, freighters, etc.
- Temporary installations such as disaster recovery and emergency situations, exhibitions, sporting events, etc., where Internet access is required for a short period.
- Quick setup for new branches waiting for xDSL/Ethernet WAN (e.g. NBN)
- Remote locations with no fixed line or NBN coverage.
- Load Balancing or Failover backup for an existing primary Internet connection which can be any of ADSL/VDSL/Cable/Ethernet broadband.

Key Features

- Card slot for FDD & TDD 4G LTE SIM card supports band B1/B2/B3/B4/B5/B7/B8/B28/B40
- VDSL2/ADSL2+, Gigabit Ethernet WAN port, 1 x USB port, and 1 x 4G LTE SIM card slot
- 1 x USB 2.0 port for 3G/4G LTE Modem, FTP server, network printer or temperature sensor
- Single WAN or Multi-WAN Load Balance and Failover
- 4 x Gigabit LAN ports with multiple subnets and 50,000 NAT sessions
- Integrated IEEE 802.11ac (AC2000) Wave 2 wireless Access Point; dual band; up to 1.7Gbps throughput for Vigor2862Lac
- Object-based SPI Firewall and CSM (Content Security Management) for network security
- Supports QoS functions
- IPv6 & IPv4
- Increased IP addresses (1022) and IP subnets (8)
- 16 x VLANs for secure and efficient workgroup management
- 32 x VPN tunnels (including 16 x SSL VPN tunnels) with comprehensive secure protocols
- Fast VPN throughput, VPN load-balancing and backup for site-to-site applications
- High Availability mode
- Central AP Management for deployment of multiple wireless VigorAPs
- Central VPN Management for 8 remote Vigor routers
- Free Smart Monitor Network Traffic Analyzer (30-nodes)
- Supports VigorACS 2 (Central Management System) for multi-site deployment
- 2 years back to base warranty



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Printed by Blue Star Print

Distributed in Australia and NZ by Gordon and Gotch
www.gordongotch.com

ISSN 0728-441

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Future plc is a public
company quoted on the
London Stock Exchange
(symbol: FUTR)
www.futureplc.com

Chief executive Zillah Byng-Thorne
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There's no such thing as bulletproof digital security

But, thankfully, there are simple things
you can do to reduce your exposure.
APC's editor Dan Gardiner explains.



It's no huge secret
that the last 12
months have been a
terrible period when
it comes to digital
security. Several
major technologies
that form the
bedrock of our

modern computing era have been
shown to have critical
vulnerabilities. We've seen KRACK
undermine Wi-Fi and Spectre/
Meldown go to the very core of our
smartphone and computer
processors. In some cases, these are
problems that can't be 100%
protected against with software
updates – although installing the
latter can mitigate the chance of an
attack being successful to odds that
are almost as good.

The good news is that cyber
criminals are fairly savvy (and/or
lazy) when it comes to choosing
who they go after – meaning unless
you're a government employee or
contractor, you work in an industry
with super-secret trade secrets
(and no, the '11 secret herbs and
spices' don't count), or you're a
journalist covering geopolitically
sensitive countries topics (like, say,
China or Russia), it's unlikely
anyone is going to specifically
target you for hacking. Like any
good business operators, cyber
crims want to see a good return on
investment for their time, so they

build viruses and exploits with the
aim to infect as many machines as
possible – to grab the low-hanging
fruit, as it were. This means the
best thing you can do to protect
yourself is get yourself higher up
in that tree, and harder to reach.

How? Simple: give yourself a
security audit and make sure
all your devices have the latest
firmware and software updates.
Your smartphone, day-to-day PC/
laptop and home router should be
the first hardware you check,
alongside frequently-used software
like your web browser. It's worth
remembering that the devastating
'NotPetya' ransomware attack
that affected tens of thousands
of devices back in mid 2017 was
largely made possible because
people hadn't installed the latest OS
patches. As much of a pain in the
arse as those Windows updates can
be, they do also protect you from
many common security
vulnerabilities.

You can check out this month's
superguide for key advice on other
areas, like passwords and surfing
the web safely – but making sure
you install the latest software
and hardware updates should be
your first port of call. ■

DAN GARDINER
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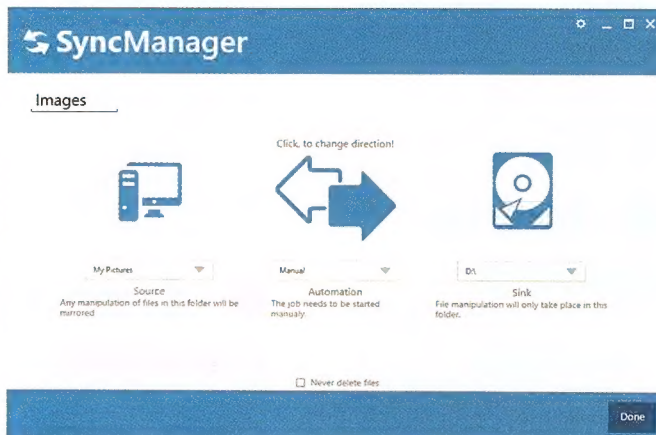
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Chinese tech giant Huawei says AU's security concerns over 5G are overblown

SAYS IT'S "GOOD AND SAFE" IN OPEN LETTER.

From a security standpoint, Huawei has copped a lot of flack from US and Australian authorities lately, so the company has written an open letter saying it is "good and safe" for the country, and having it participate in the upcoming 5G rollout will do no harm to Australian security. Huawei Australia Chairman John Lord claims the allegations against the company are "ill-informed and not based on facts" while pointing out that it has invested in 5G infrastructure in the UK and New Zealand, business it could lose if it broke rules. **SS**

Apple admits that some newer MacBook keyboards break too easily

4-YEAR REPAIR PROGRAM WILL FIX THEM FOR FREE.

Apple's second generation ultra-slim butterfly-switch keys that appear on MacBook and MacBook Pro models sold between 2016 and 2017 have created a headache for the Cupertino company. The optical keys on these models are reportedly twice as likely to fail than those found on the 2014 iteration, a problem that has led to multiple class action lawsuits. Apple is only just now publicly admitting that "a small percentage" of its keyboards don't work as intended, and has established a 4-year repair program that'll fix the faulty keyboards for free. **JB**

Intel planning to release a discrete GPU by 2020

DOES IT HAVE ENOUGH INTEL TO MAKE THE DEADLINE?

After poaching AMD's top Radeon architect, Raja Koduri, back in 2017, Intel has revealed that it's been taking additional steps towards realising its graphical-processing dreams. In June, the traditionally CPU-focused manufacturer announced via Twitter that, "Intel's first discrete GPU [is] coming by 2020". Intel's data centre group VP told ZDNet that the upcoming range will include AI, gaming and professional GPUs. **JB**



WPA3 Wi-Fi security gets certified

But some researchers claim new standard doesn't go far enough.

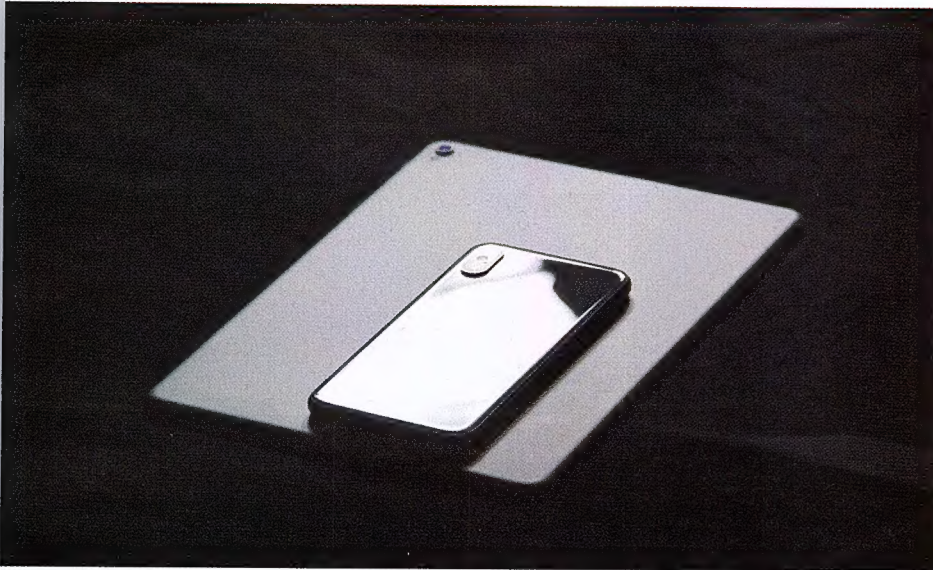
Wi-Fi devices have been using the decrepit WPA2 security protocol since it first started rolling out in 2004, and the Wi-Fi Alliance — the organisation that looks after Wi-Fi standards — has now finally begun certifying its successor, WPA3, some 14 years later.

WPA3 debuts Simultaneous Authentication of Equals (SAE), a security protocol that provides better defences against potential password guessing attempts, as well as Protected Management Frames (PMF) to defend against malicious parties eavesdropping on data transmissions. Homes using WPA3-supported routers can expect a tougher system of password-based authentication, even when they choose a weak password, while WPA3-Enterprise protocol for businesses could have ramped-up 192-bit encryption to protect their data. WPA3 also features Easy Connect, a new system which makes it easy to hook up IoT devices by just scanning a QR code. While most security experts are excited by these changes, Mathy Vanhoef — credited for discovering the key reinstallation attack, aka KRACK, in October 2017 — claims WPA3 is "a missed opportunity". He explains that, out of the four new features announced, only the SAE (or dragonfly handshake) is mandatory for WPA3 certification. "I fear that in practice, this means manufacturers will just implement the new handshake, slap a 'WPA3 certified' label on [the device], and be done with it," Vanhoef said. **Sharmishta Sarkar**

Qualcomm Snapdragon 1000 SoC leaks online, appears to be aimed at 2-in-1 market

THIRD ROUND OF MOBILE CHIPS POTENTIALLY ON PAR WITH INTEL'S Y- AND U-SERIES CPUS.

While we're still coming to terms with the reality of Qualcomm's first Snapdragon chipset to run a full Windows 10 OS, some critical details about the upcoming Snapdragon 1000 SoCs have already surfaced online. The Snapdragon 835 that's widely used in high-end smartphones has only recently become available on 2-in-1 devices like HP's new Envy x2 (see page 19). Even this chip's successor, the PC-only Qualcomm Snapdragon 850, was only revealed at Computex in June this year — so it's very early to get a peek at Qualcomm's plans for a 'third-gen' Snapdragon 1000 chip. First highlighted by website WinFuture, the leak suggests the 1000 SoC will be designed to draw a total of 12W of power, with 6.5W of that going directly to the CPU. This puts the ARM-based chip pretty definitively between Intel's efficient Y and U CPU offerings, which draw 4.5W and 15W, respectively. With 16GB of RAM, two 128GB flash drives, a Gigabit 802.11ad Wi-Fi chip and Gigabit LTE connectivity, the 20 x 15mm Qualcomm package is expected to offer similar performance to a Skylake Intel U-series chips from 2017, but with considerable power savings. **Joel Burgess**



Apple fined \$9 million for misleading Australian customers over Error 53 claims

Warranties unaffected by third-party support.

Australia's consumer watchdog, the ACCC, took Apple to court in April last year for its uncompromising repair and warranty policy, specifically regarding the Error 53 bug that plagued iOS users in 2016. The ACCC alleged that the tech giant made "false, misleading, or deceptive representations on consumer guarantees" that are protected under Australian Consumer Law. The ACCC has won the case, with a federal court slapping Apple with a \$9 million fine.

The legal action was the result of an investigation conducted by the ACCC after numerous iPhones and iPads generated the error after being updating to iOS 9, which had a feature that could detect if a device had undergone third-party repairs. Apple refused to help the affected customers on the premise that they hadn't utilised the company's own services to fix their faulty device. However, the court "declared the mere fact that an iPhone or iPad had been repaired by someone other than Apple did not, and could not, result in the consumer guarantees ceasing to apply, or the consumer's right to a remedy being extinguished," explained ACCC commissioner Sarah Court. **Sharmishta Sarkar**

Facebook has lost up to 1.8m Aussie users since the Cambridge Analytica privacy scandal

2.25 MILLION MORE HAVE CHANGED THEIR PRIVACY SETTINGS.

Since it was revealed that upwards of 87 million Facebook users worldwide had their data mined and used for political purposes by Cambridge Analytica in 2016, the social media behemoth has come under considerable scrutiny over concerns around user privacy and the security of the personal information which it keeps. Research conducted by online research firm Pureprofile has concluded that, since the scandal, 12% of all Australian Facebook users have deleted their account, which equates to 1.8 million of the total 15 million Aussie users that were most recently estimated to use the service.

While many Australian users closed down their accounts entirely, a larger proportion went in and adjusted their privacy settings, with 14% of all users claiming to have done so. Although some 2.25 million Australians edited their Facebook settings regarding personal information, we were actually the least likely to do so when compared with the UK, US and New Zealand. We also found the process the most baffling, with 66% of all users reporting it to be either difficult or very difficult to understand the settings — the most out of any of the surveyed countries. **Harry Domanski**



NBN Co would have to compensate customers for poor service under Labor proposal

NEW 'SERVICE GUARANTEE' TAKES AIM AT INCONVENIENT DELAYS.

A new proposal from the Australian Labor Party would see NBN Co beholden to a wholesale service contract, requiring it to meet certain performance standards (such as avoiding missed appointments and delays to fault repairs) or else face fines and have to compensate end users. The specific details surrounding the extent of the penalties would be left to the ACCC to decide in conjunction with NBN Co and other stakeholders if the proposal goes ahead. **HD**

Facebook wants to know if you'll pay for your favorite groups

FREE SOCIAL MEDIA IS THINNING.

Fresh on the heels of news that Facebook's Messenger service is trialing autoplaying video ads, the social media giant is testing the waters with paid subscriptions to user-created groups. Administrators of a select-few groups will be able to charge between \$4.99 and \$29.99 a month for the privilege of being a member, acting as guinea pigs to see how willing users are to pay for group content. **HD**

NSW schools could face a smartphone ban

DUMBPHONES COULD MAKE A SCHOOLYARD COMEBACK.

The NSW Government is reviewing a proposal lead by child psychologist Dr Michael Carr-Gregg to ban all smartphones in the state's schools. With concerns over distractions such as Instagram, Snapchat and more, as well as increasing accounts of cyber-bullying, Dr Carr-Gregg suggests students should only use feature phones, which retain the ability for a child to contact their parents while removing internet access and other distractions. **HD** ■

numbercrunch

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS

70%

PERCENTAGE OF NEW NBN CUSTOMERS THAT ARE NOW OPTING FOR HIGHER SPEED TIERS.

NBN Co has managed to get 70% of new contract sign-ups to opt for a plan that's 50Mbps or faster, a trend it's claiming is due to the new pricing scheme that was introduced in December, which offered wholesale discounts to service providers. While responsibility for this also falls in part to the telcos relaying these discounts to end users, this uptake brings the total number of NBN users on 50Mbps or faster plans up to 44% — almost tripling the 16% figure it was before December.



1 in 3

A THIRD OF AUSSIE NBN USERS WISH THE SERVICE NEVER EXISTED.

Out of almost 1,000 Australian NBN customers that were interviewed by comparison website Finder, 34% said they'd switch back to their previous internet connection if they had the chance. The reasons given for the dissatisfaction varied, but the majority either found their previous setup faster, or had fewer dropouts and was generally more reliable. Of the respondents, the most unhappy NBN customers were Victorians, followed closely by New South Welshman, then Queenslanders.



US\$46 BILLION

THE USE OF UNLICENSED SOFTWARE IS CLAIMED TO BE COSTING THE INDUSTRY BILLIONS.

A study conducted by the Business Software Alliance (BSA) has found that 37% of all downloaded software is unlicensed, and hence illegal, equating to a commercial value of US\$46 billion. Although that's perhaps an alarming figure, it's one that's been steadily declining over the last few years, dropping 2% since 2015. BSA attributes this in part to the decrease in PC shipments, but predominantly to an increase in the uptake of software compliance practises employed by businesses.



50%

PROPORTION OF WINDOWS 10 USERS WHO HAVE EXPERIENCED A PROBLEM WITH THE OS.

According to UK consumer watchdog Which, no less than half of all Windows 10 users have been beset by problems with their PC. This conclusion comes from a survey of 1,100 members of Which, with the most prevalent flaws being comprised of software-compatibility issues, as cited by 21% — including apps that failed to run entirely following an update. Hardware problems, such as a peripheral not working following an upgrade, were also commonplace, affecting 16% of those surveyed. ■

tech**brief**

» CARMEL SEALEY WADES INTO A CURRENT NEWS TOPIC TO TAKE A CLOSER LOOK

Drones are spreading their wings

Far beyond your weekend toy, drones are becoming a versatile piece of the tech landscape.

While you may consider the drone to be little more than a fun remote-controlled device you might fire up every now and then to take a few cool nature shots or annoy the neighbour's dog, it has uses far beyond the boundaries of your back garden or local park. Whether that's helping scientists with field tests or saving lives (animal and human), they've got more to offer than delivering your Amazon wishlist! Here are some examples of amazing beneficial endeavours being carried out with the help of unmanned aerial vehicles.



Distributing sterile mosquitos to combat Zika

Each year, millions of people die from mosquito-carried diseases, and while the media hasn't recently been as focused on Zika as it had been back in 2017, the illness is still around and still in need of a solution.

Distributing large numbers of sterile male mosquitos, which have been bred in captivity, is one method to combat mosquito populations, but how to scatter them far and wide? WeRobotics (werobotics.org) has been brought on board to deal with this problem by carrying the sterilised mozzies via drone to the desired locations, and distributing them evenly across an area. The organisation is currently conducting studies to see how successful their efforts have been.



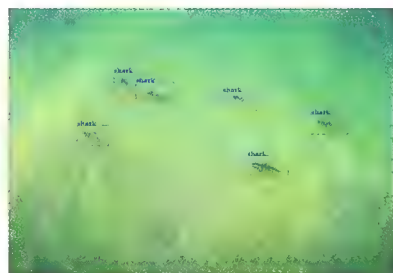
Monitoring endangered animals

Wild creatures are often hard to spot for the hard-working humans trying monitor their numbers from the backs of jeeps or on foot. A team of scientists from Liverpool John Moores University has developed a drone with infrared image-capturing capabilities to help. This unit automatically identifies animals from their heat signature, which is easier to see through long grass than the animal's actual shape, thanks to their natural camouflage.



Delivering medical supplies between hospitals

While not yet operational outside of the limited testing area, drones have been used in Switzerland to transport blood and other supplies between hospitals. Silicon Valley startup Matternet, responsible for the test, is hoping that this will lead to a "distributed network" that is "true peer-to-peer", with each hospital operating its own base of drones that can respond to demand, cutting out the third-party courier services they all currently use.



Detecting sharks in Australian shallows

The Westpac Little Ripper Lifesaver family is a favourite of ours. As well as deliver lifesaving equipment to people in distress on and off land, one of their drones boasts an artificial intelligence-based system that is "able to detect sharks with high accuracy, in real-time". This tech has been developed by the University of Technology Sydney and its potential to hasten reaction times on Australian beaches to the presence of our toothy fish friends is immensely valuable.

Help anti-poaching efforts

Former special ops sniper Damien Mander created the International Anti-Poaching Foundation to combat the highly technical approach that poachers now employ to go about their murdering of innocent animals. The IAPF currently covers over 1 million acres, and monitoring all that with just boots on the ground is hard. Drones with thermal and night-vision tech help the foundation's rangers cover that area more quickly and with great success. ■

gadgets

» GEAR WE WANT

PARROT ANAFI

Polly want a foldable 4K drone?

US\$699 | WWW.PARROT.COM

Parrot's new foldable 4K drone is constructed from a carbon fibre and glass microbead frame that allows it to be lighter and smaller than the company's previous Bebop 2... even though the Anafi contains a lot of newer, updated tech. Top of that update list is a three-axis gimbal-stabilised 21MP camera that allows up to 2.8x optical zoom and 180° of physical vertical roll, plus the ability to capture 4K HDR videos to a microSD card. The Anafi is a fraction slower than its predecessor in terms of maximum km/h, but maintains the same 25-minute battery life. The new device also hooks up with Parrot's existing Freeflight 6 app for advanced shooting modes, like 'follow me'. **JB**



ACTON BLINK QU4TRO

The four-wheel drive e-skateboard.

US\$1,699 | WWW.ACTONGLOBAL.COM

Electric skateboards have progressed beyond the point of novelty, with many now offering enough range to make them a viable option for many people's daily commute. Acton is one of the more established e-skateboard makers, and the Blink Qu4tro will be its fourth deck — so what better way to signify that than with a four-wheel-drive device. The quad-motor array allows the device to push a rider along at speeds up to 40km/h or climb hills with an impressively steep 30% incline ratio. This 10kg beast also contains a massive battery and regenerative braking, giving it an enormous maximum range of 35km. **JB**



PORSCHE MISSION E CROSS TURISMO

Putting the E in Porsche.

£TBA | WWW.PORSCHE.COM/AUSTRALIA

While the Porsche Mission E Cross Turismo is still some way off, with availability slated for late 2019, the first review models have hit the tarmac and there's apparently a lot to like about the German automaker's first mainstream fully-electric car. A 440kW 600hp electric motor pushes the four-door sedan from 0-100km/h in 3.5 seconds, which makes it a little slower off the mark than a totally kitted out Tesla Model S, but Porsche says that it'll be able to do that in quick succession without overheating. The Mission E Cross Turismo has a range of about 500km and can reportedly recharge to 80% capacity (or a 400km range) in just 15 minutes. There's even a custom drone that'll launch from the boot and autonomously film while you drive. Just what every car driver needs...! **JB**





RUGGIE

The alarm that actually forces you to get up.

US\$69 | RUGGIE.CO

It can be tempting to switch off your morning alarm and catch some extra shut-eye. Finding it hard to get out of bed is the reason so many of us oversleep, but Ruggie seeks to solve the problem by making you get up onto your feet rather than hitting snooze. It operates the same as any alarm clock but in the form of a small rug that you place next to your bed. When your alarm sounds, the only way of switching it off is to stand on it for three seconds. Once you're on your feet, it's a lot less tempting to get back into bed. While this sounds equally horrifying and amazing, we're interested to see whether this sort of tech has a future or whether it'll end up being someone's welcome mat instead...

SONY CYBER-SHOT RX100 VI

Capture the moments that count with this no-compromise compact camera.

\$1,699 | SONY.COM.AU

Looking for a powerhouse travel camera to accompany you on your adventures? Sony's latest compact camera could be the one, thanks to its full zoom range and high-speed performance. The Cyber-shot RX100 VI houses 24-200mm optics to deliver what should be superb image quality, with a zoom range from wide-angle to telephoto, plus a Clear Image Zoom function that enables you to digitally enlarge the middle of any image with minimal image degradation. There's plenty of other features to get excited about, including a hybrid AF system that gains focus in as little as 0.03 seconds, a Touch Shutter-compatible tilting LCD monitor, 4K HDR compatibility, an electronic viewfinder, and Wi-Fi, NFC and Bluetooth compatibility.



ENCHROMA GLASSES

A budget drone for racing.

FROM US\$349 | ENCHROMA.COM

Around 300 million people in the world have colour vision deficiency (CVD), but US company EnChroma have developed innovative glasses that can help restore some colour to their lives. These glasses use a colour-filtering lens to re-establish an accurate ratio of light reaching the eyes. This allows the wearer to view an enhanced vibrancy of colours and improve depth and detail perception. EnChroma's glasses are said to help 80% of people with CVD, but they are not a cure for the condition and do not provide 100% colour vision. Still, they sound like a great endeavour and they look like a regular pair of sunnies! ■



tech

INSIDE APC

GAMING ROUTERS COMPARED

apc

YOUR EXPERT GUIDE TO TODAY'S LATEST

PROTECT YOURSELF FROM HACKERS & SNOOPS

SURF THE WEB SAFELY
RECOVER FROM RANSOMWARE
CHECK YOUR PHONE'S BATTERY HEALTH

GET ON TOP OF YOUR GAME
A NEW READY-TO-PLAY ROUTER WITH ADVANCED GAMING FEATURES ON TEST
CAN THEY REALLY HELP YOU SMASH THE COMPETITION?

PERFECT PASSWORDS MADE EASY
GET SET UP IN APC'S FAVORITE PASSWORD MANAGER WITH OUR COMPREHENSIVE TUTORIAL

DOES YOUR ANDROID NEED ANTIVIRUS?
IS YOUR PHONE'S BUILT-IN PROTECTION REALLY ENOUGH TO THWART NISILE THREATS?

SECURITY SUPERGUIDE

THE COMPLETE 2018 GUIDE TO SAFEGUARDING ALL YOUR DEVICES & ONLINE ACCOUNTS

PRACTICAL NEW TECH TUTORIALS

> MACHINE LEARNING MASTERCLASS
> CREATE A RASPBERRY PI MULTI-ROOM AUDIO SETUP
> CHECK YOUR PHONE'S BATTERY HEALTH

LATEST PCs & TECH FULLY LAB TESTED

> ASUS TUF GAMING LAPTOP, DESIGNED TO LAST LONGER
> GAMING STURDY-WIDE LCD, IT'S LIKE TWO SCREENS IN ONE
> HP ENVY X2: THE ARM-BASED 2-IN-1 WITH FULL WINDOWS



the

apc RECOMMENDS

ASUS TUF FX504GE

the best gaming laptop is playing the long game

ASUS's new 15.6-inch gaming laptop is a device company reckons has been designed to withstand the test of time — or, at the very least, to outlive its contemporaries. While it features a combination of an Intel Core i7-8750H CPU, 16GB RAM and entry-level Nvidia gaming graphics card, ASUS reckons the TUF will be sturdier, more reliable and have a longer lifespan than a 'standard laptop' thanks to a few new integrated technologies. In Australia, ASUS has made the FX504 available in two variants. The cheaper of the two is the \$1,499 FX504GE, which offers an Nvidia GeForce GTX 1050 graphics card, 128GB solid state drive, 1TB hard disk and a 1080p 120Hz panel. Then there's the \$2,599 FX504GE, which has an upgraded GTX 1050 Ti GPU, a larger SSD, a 1TB 3.5-inch hard disk drive and an IPS display. Alongside that new, so-called CPU — which, in theory, will help spread processing loads and keep the system cool — and the system's fan layout, the TUF FX504 also has a new Anti-Dust Cooling system to actively expel system-damaging dust before it can collect on fan blades and metal parts. Two capture tubes in the intake have dust particles redirected into them by the over-panel fan, so they're not a concern. The laptop's chassis is a conventional, albeit, the peak CPU temperature we recorded was a better than average 82°C.

The TUF FX504's so-called switched circuitry also has a 1.8mm travel distance that holds up adequately for both typing and gaming, and the 15.6-inch 120Hz panel means there's enough space for a full-sized keyboard (plus, it even got some extra design perks, like the silent fan below the 1080p display group that keeps your hand well ventilated and the keyboard is reportedly twice as durable as the industry standard). The TUF hasn't assumed on processing power with the high-end 8-core Intel CPU and 16GB RAM combo score as well in benchmarks across the board. The 1050 Ti GPU really is the sweet spot when it comes to budget gaming, with performance sitting almost perfectly between the GTX 1050 and the GTX 1060, giving a playable 30FPS plus on modern titles at Ultra/1080p settings. The less expensive FX504GE model features a 128GB SSD connected via PCIe for 1,500MB/s read speeds, while the FX504GE gets a larger 256GB drive. But sadly, it's not on the PCIe — defaulting to a SATA 500MB/s interface for read and write speeds of just 500MB/s. Both units offer an extra 1TB of storage, but while the CD model uses a regular HDD, the GE has a Seagate 5400RPM hybrid drive that boots a mini SSD.

Verdict
Features ★★★★★
Performance ★★★★★
Value ★★★★★
It's not quite the ultimate power of the TUF FX504GE, but it's a good enough power for gaming.



HP Envy x2



Acer Swift 3 (SF315-41G-R8Z5)



AMD Ryzen 5 2600

Inside APC

Find out all about APC's editorial policies, test practices, how to read the benchmark results and more.

APC is Australia's oldest consumer technology magazine — having been consistently in print for over 35 years, since our first issue way back in May 1980 — and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer — it's in our name, after all — the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And like you, APC's journalists want to know what's good in tech — no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men, however, and APC aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives — the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in APC are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an APC reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, APC still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in APC, you can assume that higher is better. There are certain tests that deviate from this rule and where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.



The home of technology

techradar.com

how it's done



Huawei P20 Pro

Pro by name, pro skill necessary to get inside...

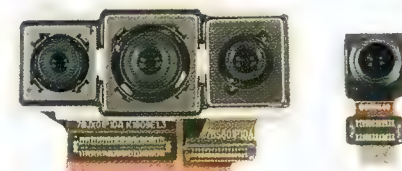
Huawei is angling for the high-end segment with its three-eyed raven P20 Pro. It has packed a ton of tech in here, what with three cameras, plus a 24MP selfie cam – all topped off by a notched display. Hate it or love it, we're tearing it down.

MAJOR TECH SPECS

- 6.1-inch OLED touchscreen with 2,240 x 1,080 (408ppi)
- Octa-core Kirin 970 with Mali-G72 MP12 GPU and a dedicated NPU
- Triple-camera 40MP + 8MP + 20MP, f/1.6 and f/2.4 main camera unit by Leica
- 24 megapixel (no, that's not a typo) f/2.0 selfie camera
- 128GB storage and 6GB RAM
- Android 8.1 Oreo

KEY FINDINGS

- Huawei has opted to notch the display of the P20 around its camera and earpiece speaker. Compared to its predecessor, the P10, this new Huawei comes with some beefed-up dimensions: at 15.5 x 7.39 x 0.78cm and 180g in weight. It also boasts three cameras on the back. The 40MP and 8MP cameras work together to get a 3x optical zoom.



The three rear cameras alongside the front-mounted 'selfie' camera give you plenty of options.



Be careful not to damage this cable when you do get inside; it's just short enough to accidentally destroy.

- The 20MP monochrome camera brings extra detail and sharpness.
- But enough about the outsides – in teardown land, it's what's inside that counts. Eliminating pesky pentaplates was a welcome move, but no screws at all? Time to try our luck with the trusty iSlack. To our surprise, the P20 Pro opens almost as easily as a flower in the spring sun. Almost. We've never had to use an opening pick on a flower. This teardown is really starting to bloom, look at all that techy nectar – uh, is this metaphor getting away from us?
- We go to remove the back cover and are foiled! No fingerprint scanner back here, and there's still a cable primed to be ripped during opening – looks like Huawei opted to mount the laser autofocus sensor on the rear case to stack it over the cameras. We finally get our hands on some screws and make quick work of the NFC antenna and motherboard shield.
- Finally, we come to the brains of this operation – the motherboard – and wrestle it free from its various connectors. Huawei once again sticks to its usual motherboard design, opting for a wider battery and a smaller 'board than some other Android phones. The trio of cameras

- comes along for the ride, holding fast to the board, with the rear flash module in tow. The three rear cameras get by with just two connectors – the main camera and the monochrome camera share one port, while the telephoto camera gets the other all to itself.
- Usually, we don't like barriers between us and necessary battery replacements, but we might make an exception for the modular charging port. That'll be a painless replacement. Since we got this far without heat, we stay cool and attack the battery glue with some drops of magic. Wait just a tick – then, opening pick. As smartphone batteries go, this one's a heavyweight – 4,000mAh at 3.82V, or 15.28Wh.
- **Repairability Score:** 4 out of 10 (10 is easiest to repair). Many components are modular and can be replaced independently. Replacing the battery is possible, but at the expense of some time and effort. Double the risk of breakage with glass front and back. Replacing the screen requires going through at least two layers of adhesive and some disassembly. ■

Navigating the maze of digital-privacy fine print

GDPR is a welcome change in Europe, but it won't stop companies trying to tricking us into volunteering our data, writes Shaun Prescott.

If you've ever ordered something from Europe, or signed up for an account with a European website, chances are you received (or have been bombarded by) emails concerning the new General Data Protection Regulation. This is a sweeping set of reforms to how companies and organisations deal with the personal data of its users. In other words, it "regulates the processing by an individual, a company or an organisation of personal data relating to individuals in the EU." Whether you regularly shop with an EU-based outlet, or whether you bought a sole packet of fancy doilies from a German outlet in 2009, you probably got an email.

Naturally, the introduction of the GDPR doesn't have everyone satisfied that privacy measures will be undertaken seriously, especially by the likes of Facebook, Google and Microsoft. According to a report in The Register last month, a handful of consumer privacy groups have approached the European Data

Protection Board, requesting that it place further scrutiny on the tech giants. Whether the companies are technically abiding the GDPR isn't really in question; rather are these companies using underhanded tactics in order to make users inadvertently volunteer their personal information?

The five consumer watchdogs included Consumers International, Privacy International, BEUC, Norwegian Consumer Council and ANEC. You've probably not heard of these, but it doesn't really matter: what matters is they penned a joint letter to the GDPR with a fairly strong accusation. In the letter's words, "companies employed numerous tricks and tactics to nudge or push consumers toward giving consent to sharing as much data for as many purposes as possible."

It continues: "These include privacy-intrusive default settings, giving users an illusion of control, dark patterns such as hiding away privacy-friendly choices, and take-it-or-leave-it choices."

The report this letter alludes to, published by the Norwegian Consumer Council and entitled 'Deceived by Design', has the overall conclusion that regulations that enforce certain freedoms to consumers can't really pick apart the underhanded ways companies can trick you into volunteering your data. And they're right: few weeks pass without an article published online demonstrating the labyrinthine obstacles one must overcome in order to stop Google gathering information the user didn't even know was being gathered.

One could make the argument that it's the user's responsibility to make sure their privacy settings are optimised. But in this day and age, at a time when the likes of Google and Facebook are less "service providers" and more "baked into virtually every part of our daily life", it's essential that more transparency be enforced.

For most people in the 21st century, it's simply not an option to opt-out of using these services. They've indelibly changed our reality. ■

END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.



GAMING LAPTOP

FX504GE, \$1,799; FX504GD, \$1,499 | WWW.ASUS.COM/AU

ASUS TUF FX504GE

This budget gaming laptop is playing the long game.

ASUS's new 15.6-inch gaming laptop is a device the Taiwanese company reckons has been designed to withstand the test of time... or, at the very least, to outlive its contemporaries. While it features a combination of an Intel Core i7-8750H CPU, 16GB RAM and entry-level Nvidia gaming graphics card, ASUS reckons the TUF will be sturdier, more reliable and have a longer lifespan than a "standard laptop" thanks to a few new integrated technologies.

In Australia, ASUS has made the FX504 available in two variants. The cheaper of the two is the \$1,499 FX504GD, which offers an Nvidia GeForce GTX 1050 graphics card, 128GB solid state drive, 1TB hard disk and a 1080p TN-panel. Then there's the FX504GE that we tested, with an upgraded GTX 1050 Ti GPU, a bigger SSD, a 1TB hybrid hard disk drive and an IPS display.

Alongside that new six-core CPU – which,

in theory, will help spread processing loads and keep the system cooler (and therefore last longer), the TUF FX504 also has a new Anti-Dust Cooling system to actively expel system-damaging dust before it can collect on fan blades and metal grills. Two capture tubes in the intake have dust particles redirected into them by the centripetal force of the fan blades, and a cutaway on the hinge-edge of the laptop shell creates space for a bigger fan vent and up to 27% greater thermal dispersion over a conventional laptop (the peak CPU temperature we recorded was a better-than-average 82°C).

The TUF FX504's scissor-switched chiclet keys have a 1.8mm travel distance that hold up adequately for both typing and gaming, and the 15-inch form factor means there's enough space for a full sized keyboard (just). It's even got some neat design perks, like the inlet fan below the WASD key group that keeps your hand

well ventilated, and the keyboard is reportedly twice as durable as the industry standard.

The TUF hasn't scrimped on processing power, with the high-end six-core Intel CPU and 16GB RAM combo scoring well in benchmarks across the board. The 1050 Ti GPU really hits the sweet spot when it comes to budget gaming, with performance sitting almost perfectly between the GTX 1050 and the GTX 1060, giving a playable 30fps plus on modern titles at Ultra/1080p settings.

The less-expensive FX504GD model features a 128GB SSD connected via PCIe for 1,500MB/s read speeds, while this FX504GE gets a larger 256GB drive, but sadly loses out on the PCIe – defaulting to a SATA 6Gbps interface for read and write speeds of just 500MB/s. Both units offer an extra 1TB of storage, but while the GD model uses a regular HDD, the GE has a Seagate SSD/HDD hybrid drive that bolts a mini SSD

to a traditional hard drive in order to speed up retrieval time and increase longevity by reducing mechanical failure. While we can't really test durability over our typical four-week review period, this drive only managed 112MB/s in synthetic sequential read tests – slower than some of the regular HDDs we've tested, and about 2-5 times below what Seagate promotes as potential speeds.

Battery life was equally underwhelming (even by gaming laptop standards), getting just 1:28 hours for 1080p movie playback.

■ Joel Burgess

Verdict

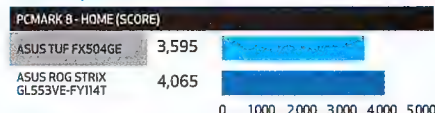
Features ★★★★★
Performance ★★★★★
Value ★★★★★

It's not quite as strong in some areas as we'd like, but the TUF FX504 is still a good value ground-floor gaming laptop.

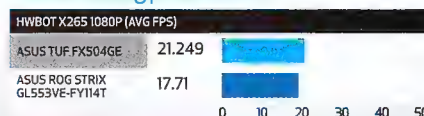


LABS BENCHMARK RESULTS

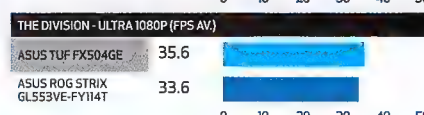
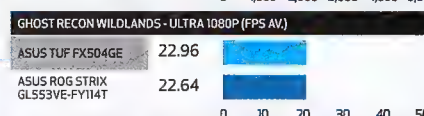
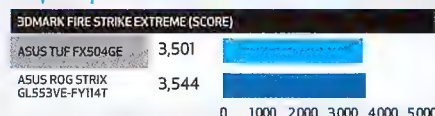
General performance



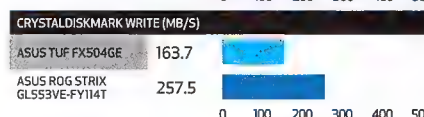
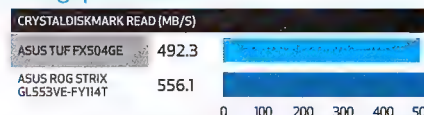
Media encoding performance



Graphics performance



Storage performance





TABLET

\$1,999 | WWW.HP.COM/AU

HP Envy x2

An ARM-based Windows tablet that won't inspire much envy.

The power gap between Intel's efficient mobile processors and the most grunty ARM-based tablet CPUs has been slowly narrowing over the last few years, and it's a rift that's finally met in the form of this HP Envy x2.

Qualcomm is the first major phone-chip maker to cross over, using a 10-nm Snapdragon 835 processor as the foundation for this first ARM-based device capable of running a full-fat version of the Windows OS. The 835 is an eight-core ARM based CPU that, according to Qualcomm, is a third smaller and 25% more efficient than its previous chips. ARM processors are built in such a way that they're more efficient in terms of power vs performance, and HP is hoping to use this feature set to create a long-lasting Windows tablet suitable for less-demanding tasks.

The caveat is that, out of the box, the HP Envy x2

runs Windows 10 S, Microsoft's locked-down Windows Store-only version of its current operating system. We'd generally throw up some objections here, but the OS's stress-tested app ecosystem and generous battery life do arguably make it a more ideal environment for this lower-powered chip.

When tested using the locked-down version of OS, the Envy x2 only lost about 20% of its battery life after 4 hours of video playback, and consumed about 10% per hour when we used it for internet browsing, document editing and other light work tasks. If you combine this unprecedented 20-odd hour battery life with the detachable's inbuilt 4G connectivity (just BYO SIM card), then you have something that is truly novel in the 2-in-1 space. This will suit many people, and for them, the HP X2 definitely makes sense.

But most of us are going to need an application that's

more demanding than the Edge browser, and while the Windows Store is better populated with apps that it's ever been, realistically it's got far fewer than what's available on Android and iOS. To combat this, HP is offering a Windows 10 Pro upgrade as a freebie, but if you're even considering this, we have one word of advice: don't. Just don't.

That's because when you take the Windows 10 S training wheels off, it quickly becomes apparent that the HP Envy X2 is neither powerful enough nor familiar enough with 64-bit architecture to play nice with the full version of Windows. Even with 8GB of DDR4 memory, the Snapdragon 835 simply isn't equipped to handle the unexpected processing spikes of an open Windows 10 platform, resulting in perpetual crashes in apps like Chrome and creating a dramatically slower Edge browser experience. Moreover, while most of our

2-in-1 benchmarks weren't compatible with the ARM chip, the ones that did work showed just how poorly this processor runs Windows. The Envy scores below low-specced Windows tablets from 2014, and on PCMark 8 and Geekbench 4, it sits at around 25% the performance of cheaper recent 2-in-1s, like Acer's Spin 5 that runs an Intel Core i5. You get 11 hours movie playback battery life in Win 10 Pro, but this really isn't enough of a drawcard to balance such a considerable lack of power and a raft of compatibility problems.

■ Joel Burgess

Verdict

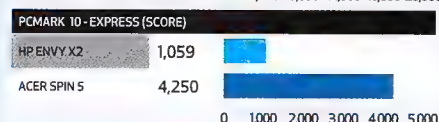
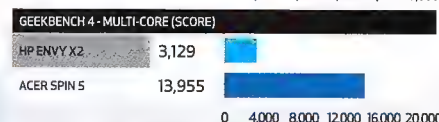
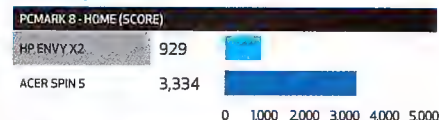
Features ★★★★★
Performance ★★★★★
Value ★★★★★

A 20-hour battery life and 4G aren't enough to counterbalance the severe lack of processing power.

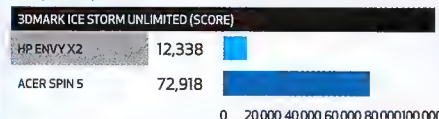


LABS BENCHMARK RESULTS

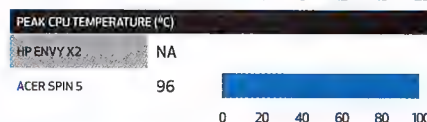
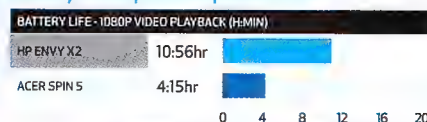
General performance



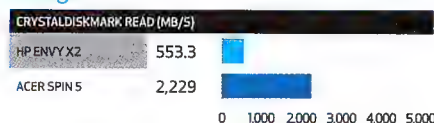
Graphics performance



Battery & temperature performance



Storage



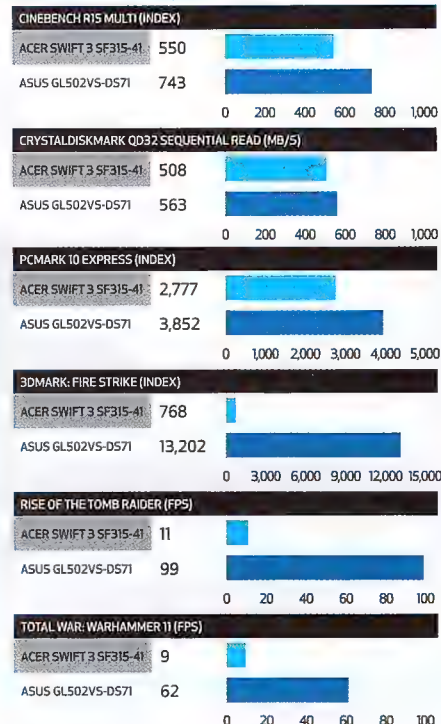


LAPTOP

\$1,199 | WWW.ACER.COM.AU

LABS BENCHMARK RESULTS

Performance Category



Acer Swift 3 (SF315-41G-R8Z5)

AMD's Ryzen makes the move to mobile.

It's debatable whether AMD has ever made a truly competitive laptop chip. Yes, AMD's mobile processors based on the Bobcat core were OK for budget devices, but Intel's domination has been even stronger in laptops than it already was on the desktop. But then Ryzen came along and proved how complacent Intel has become.

But that's just desktop, right? No. At last, Ryzen has made that transition to laptops, and we can finally tell you whether it's as big a game-changer in the portable market as it has already proven to be on the desktop.

On paper, the Acer Swift 3 is the ideal system for weighing up the relative pros and cons of the latest mobile CPUs. That's because it's one of the very few mobile rigs offered with both AMD Ryzen and Intel Core processors. Yes, variables remain, including the motherboard, but the really critical bits, such as the screen, chassis and

battery, are shared by both variants, providing about as level a playing field as you're ever going to get.

For the most part, it's a resolutely middle-market offering in a 15.6-inch form factor. It's powered here by the Ryzen 5 2500U. That's the second tier in a four-strong range of mobile Ryzen CPUs. The 2500U has the full complement of four cores and eight threads on the CPU side, but it loses a pair of compute units from its AMD Vega graphics core. Where the Ryzen 7 2700U gets 10 compute units, the 2500U makes do with five.

The 2500U is also 200MHz down on clock speed, with a base clock of 2GHz, and a maximum Boost clock of 3.6GHz. But overall, it's a good introduction to Ryzen's mobile chops. Elsewhere, the Swift 3 boasts a Full HD IPS display covered in Corning Gorilla Glass, and a 256GB M.2 SSD hooked up via SATA, rather than the powerful PCI Express interface. In terms of physical attributes, it's a

mid-sized aluminium affair, rather than a truly thin-and-light option, weighing 2.2kg and equipped with a 48Wh battery. That battery not only reveals the Swift's mid-market positioning, it also makes it tricky to get a feel for how efficient AMD's Ryzen processor is in a mobile implementation. A premium 15-inch portable, such as Dell's XPS, offers roughly double the battery capacity, for instance. Making matters worse, we had problems getting our pre-production review sample up to full charge. In short, we couldn't assess the unit's battery life at all.

During testing, this laptop kicked out a fairly mixed bag of results, both in outright terms and that performance in the same test varied widely over the course of multiple runs. We extracted scores varying from 340 to over 500 for Cinebench in multithreaded mode, even with Windows Update turned off. The graphics performance of the AMD Vega 3D core was also

patchy. Maybe the firmware needs a tweak, or the cooling hasn't had that final polish.

The overall sense is that this isn't Ryzen mobile at its best. That's a pity, not only for this laptop – it's a solid little unit, with a nice IPS panel, and a firm feel to its keyboard performance – but also for the Ryzen chip, which looks very promising. For now, we think Ryzen will give certain members of Intel's latest eighth-gen mobile CPU range a very serious run for their money, but we'll need to spend time with a better optimised system for a more detailed conclusion. ■ Jeremy Laird

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

A good overall package for the price, but with improvement needed in performance and consistency.





"The bang for buck element is definitely there. At stock, all six of those 12nm cores are pretty impressive."

CPU \$239 | WWW.AMD.COM

AMD Ryzen 5 2600

The perfect hex core for the tinkerer.

Big Blue definitely seems to have been caught off guard by AMD's recent success, but if we're honest, as much as it's good to see Team Red get back on its feet, especially in the enterprise domain (which is where the vast majority of the money lies), it's the mid-range computing segment that interests us the most – in particular, finding that sweet-spot chip that represents the perfect balance between price and performance.

Typically speaking, as you go further down the product list, you eventually reach a point where that bang for buck figure starts to decline, and you begin to see an overall decrease in value per dollar. For Nvidia, that's anything below a GTX 1050; for Intel, the Celeron series; and for AMD... well, it was the Ryzen 3 series – at least, before this generation.

The Ryzen 5 2600 is currently at the bottom of AMD's list of recently refreshed 12nm processors

(excluding the integrated GPU series), so is that old maxim true? Do we start to see a degradation in performance over price? The short answer: no.

Amazingly, in the whole lineup, the 2600 is the most cost-effective AMD part you can get right now. In our price-to-performance metric, the 2600 scores higher than every other AMD chip we've seen so far from this refresh. That makes it a pretty attractive offering for anyone looking to piece together a mid-range build. Couple this part with a 3GB GTX 1060, 8GB or 16GB of DDR4, and a 120GB SSD, and you're immediately looking at a very attractive cost-effective 1080p gaming and amateur video editor/streaming machine.

The bang for buck element is definitely there. At stock, all six of those 12nm cores are pretty impressive, scoring 159 points in the Cinebench single-core test, and 1,274 points in the multicore mode, with the rest of our computational

benchmarks following suite. That single-core result is perhaps a little lower than most are looking for in-game, but nothing so detrimental that you'll notice. Power draw was a solid result, too. Coming in at 52W at idle and 148W under load, it rounds out this chip nicely.

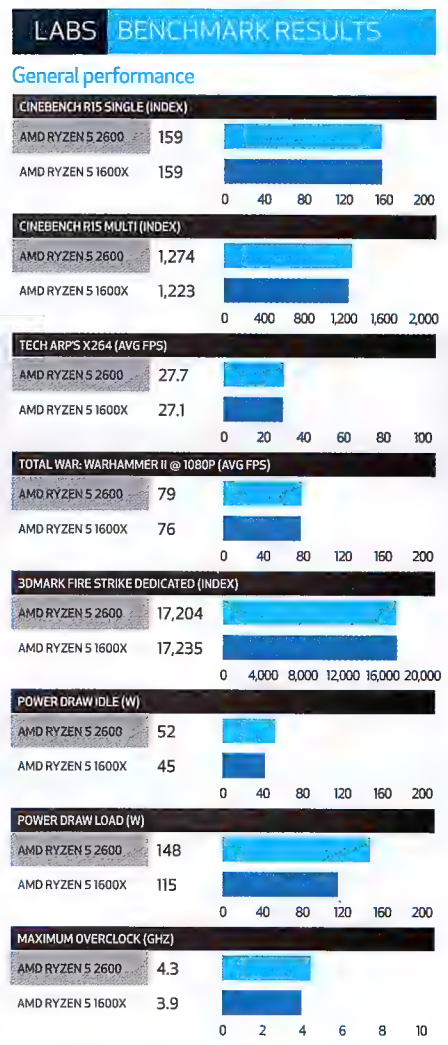
That said, everything else is kind of where you'd expect, the only notable exception being the *Total War: Warhammer II* benchmark smashing all our test subjects, scoring an average frame rate of 79fps at 1080p, toppling even the 2700X.

But, of course, for the non-X parts, the trick is how far you can push them when it comes to clock speeds. And the 2600 is no different – with a quick clock ratio adjustment up to 4.3, 1.45V dumped into the V Core, and some tweaking of the VRM settings, we managed to get a very stable 4.3GHz (or 4,290MHz) out of all six cores, no sweat. This bumped up the temps a bit,

with load temp reaching 72°C with a 360mm rad, but it was more than happy smashing through all our benchmark tests again.

The Ryzen 5 2600 really epitomises what Ryzen is all about – balance. The right number of cores, the right stock performance, the right overclocking capability, the right thermals, at the right price, and it even comes with a pretty jazzy CPU cooler, too.

If we had one reservation, it's that it still suffers from slightly higher latency issues than its competitor, but honestly, for the target audience, that matters very little. ■ Zak Storey



Verdict

Features
Performance
Value

★★★★★
★★★★★
★★★★★

The most cost-effective AMD CPU you can get right now, with a great balance of performance to price.

★★★★★



32:9 ULTRAWIDE MONITOR

\$1,999 | WWW.SAMSUNG.COM/AU

Samsung C49J89

So you said you wanted widescreen...

Stop that. It's silly. This, we wager, is roughly what goes through your mind as you regard Samsung's latest ubertron, the C49J89. It isn't just physically huge in objective terms, measuring 49 inches across its outrageously ample diagonal. It's also visually vast, thanks to its extreme 32:9 aspect ratio. Surely, this isn't sensible?

But hold on. When the first superwide 21:9 aspect monitors appeared, opinion was divided. Now they're relatively mainstream and extremely popular. Could familiarity normalise the C49J89's even wider proportions in a similar manner?

Hold that thought as we run through the key speeds and feeds. Panel-wise, we're talking 49 inches of VA shizzle with an 1800R curvature. It's good for a static contrast ratio of 3,000:1, which is nice, and peak brightness of 300cd/m², which is less stellar in this brave new age of HDR. Indeed, this reveals the key difference between

the C49J89 and its otherwise similar Samsung sibling, the CHG90. The C49J89 lacks support for HDR visuals.

That said, it does pack a pretty nifty set of broader capabilities. For starters, it runs up to 144Hz refresh, which isn't necessarily what you'd expect for a monitor aimed at productivity. Next up is a built-in KVM switch, giving you lots of options for hooking up multiple machines to drive the display. USB-C connectivity is another bonus, allowing a single cable to both drive the display and charge a laptop.

The C49J89 also supports Samsung's DeX Station interface, enabling you to dock your Samsung phone with the monitor, mirror its interface and use a keyboard and mouse to control the whole shebang. But the key specification, the one that really defines this screen, is the native resolution of 3,840 x 1,080. The horizontal figure is the same as a standard 4K or UHD display, but the vertical is just half the 4K standard. In simple terms, you have a pair of 1,920 x

1,080 FullHD monitors sitting side by side.

The upside is that you're getting that with absolutely no divide, no bezels between two displays; just one glorious, gently curved expanse. The first downside is that this is not a cheap display, and those 1,080 vertical pixels are a major limitation compared to, say, a pair of cheap 1440p panels, much less dual 4K monitors, both of which are very much doable for similar or less cash than the C49J89. The next is that, while 3,840 pixels sounds like a lot, spread across a 49-inch diagonal, they make for a pretty large pixel pitch. A Retina-style display this most definitely ain't.

In other regards, the panel quality is decent. Granted, the viewing angles are limited compared to the best IPS monitors. And it lacks pizzazz next to the latest quantum-dot and HDR-enabled screens. But that 3,000:1 contrast ratio makes for nice, deep blacks and the colours are pleasing, if not punchy.

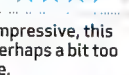
However good the panel quality, the form factor and resolution are what this screen is about. For gaming and movies, it's suboptimal. There's almost no video content this wide, and most games don't offer a field of view that makes the most of the aspect ratio. For productivity, the C49J89 makes a better case for itself as an alternative to a dual-monitor setup. But even there, the lack of pixel density and vertical resolution are problematical.

The earliest 21:9 monitors suffered from a similar lack of pixels, but even with more pixels, the appeal of ultrawide 32:9 monitors is likely to stay narrow.

■ Jeremy Laird

Verdict

Features
Performance
Value



While very large and impressive, this ultrawide monitor is perhaps a bit too pricey for its niche size.





PCIe SSD

\$740 | WWW.KINGSTON.COM

Kingston KC1000 HHHL SSD 960GB

Kingston plays the long game with its first NVMe drive.

Four years after the first SSD with support for the hot new NVMe control protocol was launched, Kingston has finally turned up to the party. Did the KC1000 swagger in fashionably late? Or has Kingston missed out on all the fun?

One of the KC1000's major selling points involves endurance rather than speed, which may be a bit surprising, given that performance is the most obvious benefit of moving from an old-school SATA drive, based on the ancient AHCI control protocol, to an M.2 drive connected via PCIe, and leveraging the solid-state optimised NVMe protocol. But the KC1000 not only offers a full five-year warranty, it also backs that up with a two million hours mean time between failures (MTBF) rating.

What's more, Kingston rates this 960GB KC1000 as good for 1PB (1,000TB) of writes. That's far nearer to the 1.2PB of Samsung's market-leading 970 Pro 1TB than it is the cheaper 970 Evo 1TB and its 600TB rating. For the record, our sample comes as part of the KC1000 HHHHL package, the latter jumble of letters signifying Half Height Half Length, referring to the bundled add-in PCIe board that allows you to use the drive in motherboards that lack an M.2 slot as standard. A bare KC1000 M.2 drive is available for fewer dollars.

As for the spec of the drive, underpinning it all is a Phison PS5007-E7 controller, and a load of Toshiba 15nm planar, rather than 3D, MLC NAND flash memory. At launch in 2016, the Phison PS5007-E7 was intended to be among the fastest NVMe controllers. Today, it isn't quite as competitive.

This 960GB model is pegged at 2.7GB/s for peak sequential reads and 1.6GB/s for writes. 4K random access performance is, again, a fair distance off the very best. At 190K and 165K for reads and writes, respectively, it's not going to worry the 500K IOPS capability of the likes of Samsung's 1TB 970 Pro, for instance.

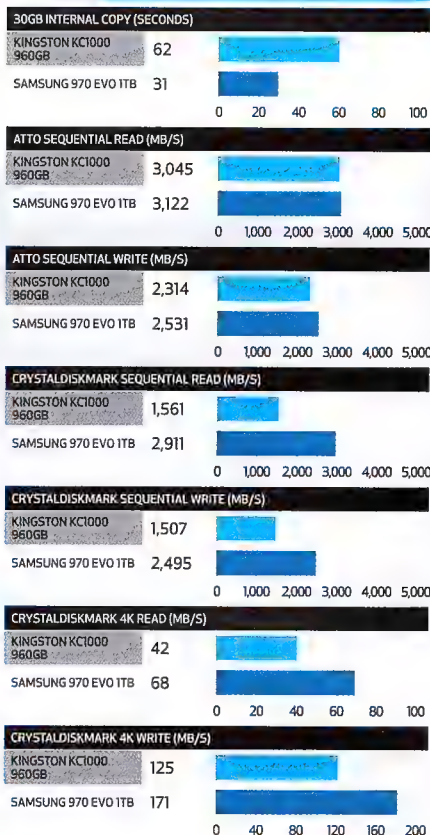
In practice, a similar performance delta applies. The peak throughput numbers in benchmarks are patchy. It exceeds expectations in the least challenging metric, ATTO Disk Benchmark. However, with peak sequential reads of just over 1.5GB/s in CrystalDisk, it's some way short of Kingston's claims. Similarly, 4K random access performance of 42MB/s for reads and 125MB/s for writes isn't merely well behind the likes of a top-end drive like the Samsung 970 Pro, it's also significantly

slower than the cheaper 1TB 970 Evo.

In real-world testing, both Samsung drives are roughly twice as fast in our internal file copy test. Similarly, during our pre-bench setup routine, we found that the KC1000's sequential throughput can drop as low as 200MB/s when copying hundreds of GBs in a sustained fashion.

Which means the KC1000 isn't exactly a no-brainer. It will blow away a SATA drive, but compared to the latest PCIe SSDs, it looks pretty ordinary. ■ Jeremy Laird

LABS BENCHMARK RESULTS



Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Its excellent 5-year warranty and strong endurance ratings contrasts starkly with its patchy performance.





NVME SSD

\$410 | WWW.SAMSUNG.COM/AU

Samsung 970 Pro 512GB

Samsung just got scarier.

SSD makers across the globe: Prepare for a world of pain. The 970 Pro is part of Samsung's third generation of high-end NVMe SSDs. Its previous efforts have been about as good as consumer SSDs got. So if third time truly is lucky, and the 970 Pro is even better, well... Samsung just got scary.

It's over 18 months since the Samsung 960 Pro debuted. That's an aeon in the ironically fast-moving world of solid-state storage.

Inevitably, there's a new controller chipset here, the Samsung Phoenix. We saw it before in the 970 Evo, the 970 Pro's cheaper sibling. Not much is known about Phoenix. Just like Samsung's previous NVMe controllers, Phoenix uses a PCIe 3.0 quad-lane interface with eight channels. It also has five CPU cores, like the outgoing Polarix.

Samsung never goes into detail when it comes to the specs of its SSD controllers. That said, Phoenix is also

used in Samsung's megamoney enterprise SSDs, so it's clearly the company's best controller tech. We also know that the 970 Pro uses Samsung's new 64-layer 3D MLC V-NAND. Such is the data density of this new gen of NAND flash memory, its 512GB TLC dies allow for 1TB in a single BGA package. That makes larger capacities easier and cheaper, even if this Pro model remains a premium-priced proposition.

Still, for the extra money, Samsung provides significantly more drive endurance. The new 970 Pro is far ahead of both its predecessor and its 970 Evo sibling in that regard. The old 960 Pro 500GB drive was rated for 400TB of writes, and the 970 Evo is good for 300TB – the 970 Pro 512GB is rated at fully 600TB.

The on-paper progression from 960 Pro to 970 Pro is significant, but not always dramatic. Max sequential reads remain pegged at 3.5GB/s, probably reflecting the real-world limits of the

quad-lane PCIe interface. Sequential writes for this 512GB model have stepped up from 2.1GB/s to 2.3GB/s. As for 4K performance, that's up from 330K IOPS for reads to 370K IOPS. Writes increase from 330K to 500K.

In benchmarks, our results indicate the peak throughput claims are pretty much on the money. Unlike cheaper drives, such as the Kingston KC1000 (see page 23), the 970 Pro maintains performance close to the claimed peak throughput, regardless of the benchmark. Even more impressive, arguably, is the 970 Pro's real-world performance. It absolutely tears through our internal file copy test, completing it in just 29 seconds. That's twice as fast as the new Kingston KC1000.

During our pre-test setup, which involves completely filling a drive before wiping it clean again, the 970 Pro sustained internal file copy speeds of around 1GB/s. Very few SSDs can achieve anything close to that kind

of sustained performance over hundreds and hundreds of gigabytes.

Overall, then, it's likely that the 970 Pro remains among the best if not the very best consumer SSD. The step forward this time is arguably a little more modest in some ways than before, but that only reflects the limitations of NAND memory tech hooked up via a PCIe 3.0 interface. A bigger leap forward probably requires a step-change tech, like Intel's 3D Xpoint.

But for now, the 970 Pro is about as good as consumer SSDs get, albeit at a price.

■ Jeremy Laird

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Excellent all-around performance, while very expensive for the capacity.





NETWORK-ATTACHED STORAGE

\$470 | WWW.NETGEAR.COM.AU

Netgear ReadyNAS 422

Throwing down the gauntlet to other NAS makers.

Here's a classic example of a modern NAS box. It's designed to be purchased for a specific job, but can be repurposed repeatedly over its working life. Can this new series of ReadyNAS hardware take on Synology in that slice of the market where it is strongest?

The RN422 is over-engineered to the point that it feels heavy even before drives are mounted. The look that Netgear is pitching with the new ReadyNAS series is a minimalist one with a twist of functionality. The fascia is hinged on the left and opens to reveal the two internal drive bays that enable either 2.5- or 3.5-inch drives to be quickly mounted. The larger drives don't require any tools to install, but you will need a screwdriver for 2.5-inch hard drives or SSDs.

For connecting external devices, one USB port is at the front under the door, and the other USB 3.0 is at the back, along with a single eSATA port. The door has a two-line LED display that's

also a menu accessed with the five illuminated buttons on the door face – most useful in diagnostic and emergency situations.

For those wanting to lock horns with Synology, the true battleground is app selection. Netgear has made the biggest improvement in this part of the ReadyNAS offering. The collection of 63 tools doesn't outnumber the choice Synology gives, but contains much of the same functionality, and even overlapping apps. Drupal, iDrive, GLPI, Joomla, LimeSurvey, Logitech Media Server, PHP, Python and SugarCRM are on both platforms, and many other apps have practically identical functionality. Both support Docker development, configured as a local DNS server or an automated torrent client. There are relatively few places these machines exclusively own.

Support for cloud services is also very good on Netgear, with 10 extra apps for working with ReadyCLOUD, ReadyNAS Vault, ReadyNAS Replicate, Google Drive,

Amazon Drive, Amazon S3, Dropbox, Microsoft Azure, OneDrive and Wasabi. The only significant hole that we noticed is that there isn't currently a Mail Server in the selection, and WordPress is also MIA.

One strong aspect of the feature base is the back-up controls that enable you to create an elaborate multi-layered plan to secure the contents of the system and any network storage in its vicinity. It can back up to (or from) with NFS, FTP and any system that supports Rsync. A back-up routine can secure files to internal storage, external storage or a wealth of cloud options. Overall, as an alternative to Synology, QNAP, Asustor or one of the other top NAS brands, the Netgear ReadyNAS 422 is a viable option and not in the least a poor cousin.

With a dual-core Atom CPU powering only a two-drive NAS box, the limiting factor here isn't the processor, memory or even hard drive speed; it's the Gigabit LAN ports. Netgear did include dual-Gigabit,

and you can leverage those to double throughput by channel bonding or other aggregation methods.

With a single Ethernet port connected and the drives set up in mirror mode, the system managed suitable 118.5Mb/s read and 117.8Mb/s write speeds. With both LAN ports active, that increased to an impressive 200Mb/s and 185Mb/s.

As an aside, you can use a Netgear EDA500 – a five-bay ReadyNAS Expansion Chassis that connects via the eSATA port – to add additional drives to the setup, but it would be cost effective to buy a system with more bays from the outset. ■ Mark Pickavance

Verdict

Features
Performance
Value



With a wealth of added functionality, this NAS is powerful enough to make the most of its recent enhancements.





TWO-PACK, \$699 | WWW.NETGEAR.COM.AU

Netgear Arlo Pro 2

Pricey but professional security cameras for the home.

Although it's currently owned by US tech giant Netgear – a company best known for its routers – it's recently been reported that Arlo is about to be spun off as a separate company due to its success. Certainly Arlo has gained a reputation for producing a range of solidly built internet-connected cameras, although how it will fare going it alone against offerings from companies such as Amazon and Google remains to be seen.

The Netgear Arlo Pro 2 is one of the company's high-end security systems. Although billed as a wireless solution, the pack of two comes with its own base station – about the size of a small router – which needs to be connected to your broadband router using the supplied Ethernet cable. Not only will you need a spare Ethernet port on the back of the router, you'll ideally need to be able to place the base station close to the router in your home. Alternatively, it is possible

to use powerline technology for greater flexibility, in which case, you can plug the base unit into a powerline socket.

The starter pack gets you the base unit and two oval-shaped white cameras, resembling oversized eggs. Weather resistant (with an IP65 rating), these can be mounted indoors or outdoors using the magnetic mounts included. Alternatively, they can be freestanding.

On the bottom of each camera are a small speaker and microphone, allowing for two-way audio. At the top are two buttons; one of these is to sync the camera with the base station, the other opens the back of the unit to reveal the lithium-ion battery. The battery needs to be fully charged either using the USB plug and lead or by plugging the camera directly into the USB port on the back of the base unit.

Setting up each camera to 'talk' to the base unit should be straightforward; by pressing the Sync button on top of the base unit,

followed by pressing the one on the camera. We encountered problems, but it seems the issue may have been with the broadband router we were using. Netgear confirmed that there have been some initial isolated issues with certain broadband routers and providers, but these are said to have all been resolved by its support network.

Once the base unit and cameras were synced, we were able to control the system easily. Each camera can be individually labelled depending on where you use it, and controlled using your PC or smartphone. You can view two live images side by side, or expand one to fill the screen.

Although the 130° field of view isn't as wide as some cameras, the image quality from the camera is excellent. Thanks to an 8x digital zoom, you can hone in on parts of the image – in the web interface or with the app's pan and zoom feature. There's a night vision mode, too.

The Arlo Pro 2 will inform you if the cameras detect motion. Each camera can be individually 'armed' to detect motion all the time or disarmed completely. There's also an option to only arm the cameras during certain hours of the day. The system also features an integrated alarm with a 100dB+ output.

Netgear's free package gets you one week of video for up to five cameras and three months' support; Premier (30 days' cloud recording for 10 cameras, at \$12.99 per month) and Elite (60 days' cloud recording for 15 cameras at \$18.99 per month) both come with unlimited support.

■ Chris Price

Verdict

Features	★★★★★
Performance	★★★★★
Value	★★★★★

Solidly built and capable of crystal-clear HD video, the Arlo Pro 2 is also expensive.





EXTERNAL HARD DRIVE

\$115 | WWW.TOSHIBA.COM/AU

Toshiba Canvio Advance 2TB

Slim and sturdy storage.

The Toshiba Canvio Advance is an external hard drive that comes in 1TB, 2TB and 3TB capacities. It offers a lot of storage for not that much money and is a middle-ranking model in the Toshiba line-up. It uses two platters and is a 2.5-inch drive, letting it slim down to 14mm thickness. Upgrade to the Canvio Premium and you shave off an extra 0.5mm and get an extra USB-C cable in the box.

As with a lot of portable drives, the Canvio's cable isn't that long, at around 45cm. And as it uses an old-style micro USB 3.0 port on the drive itself, it's unlikely many will have a suitable spare lying around. The cable ends in a standard USB port — bear this in mind if you have a new laptop that only has USB-C connectors. There's a backup utility that makes the Canvio auto-copy files from Windows folders you select, at an interval you choose, and a security app that lets you password

protect files. Both are basic, and lack the supplementary cloud some drive manufacturers offer, but are quite easy to use.

If you want amazing file-juggling performance, the Canvio is not the drive to buy. Even a budget SSD will be much faster. It does offer decent performance for a 5,400rpm drive, though. When transferring large files, it writes at 122MB/s. Transferring 10GB of data will take around a minute and a half. Write speeds level out at 141MB/s, the norm for a drive like this.

There are a few things you need to consider, but pass all those tests and you'll find this a convenient, portable way to boost your PC's storage. ■ **Andrew Williams**

Verdict

A sturdy portable drive that's slimmer, if not more advanced, than older models.



SMARTPHONE

\$1,099 | WWW.LG.COM/AU

LG G7 ThinQ

ThinQ about this.

While LG may have left behind any notion of being a game-changing phone maker in recent years, the company has become quite reliable at producing exceptional all-rounder handsets. With the new G7 ThinQ, LG has delivered a phone with sophisticated AI smarts, a fantastic dual lens camera, a stylish design, a super bright QHD+ 18.9:5 notched display, terrific audio performance and top-end specs.

LG wants its awkwardly-branded 'ThinQ AI' functionality to be the big drawcard here, but having spent some time with the phone, it's perhaps better suited to music lovers. Thanks to its built-in hi-fi quad DAC and DTS:X 3D Surround functionality (both of which require headphones to be plugged into its 3.5mm socket), the G7 ThinQ delivers an unrivalled audio experience in the smartphone arena. Switching on the quad DAC

instantly makes audio richer and deeper, providing additional bass in the process, while the latter DTS feature also impresses by offering virtual 3D surround sound regardless of the headphones you're wearing. It also packs an especially built-in loud speaker.

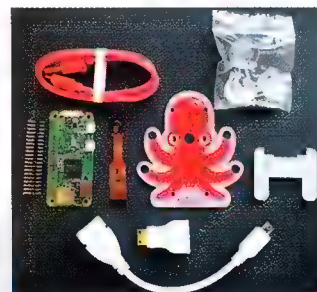
In terms of performance, the ThinQ did a good job of keeping up with the Galaxy S9 in graphical benchmarks; however, its Geekbench 4 single- and multi-core test scores (2,393/7,766) fell quite short of Samsung's S9 flagship (3,656/8,842). Battery life was also underwhelming, offering around 6.5 hours of heavy usage — an hour or two less than most others.

■ **Stephen Lambrechts**

Verdict

Small quibbles aside, LG's G7 ThinQ is the best phone the Korean company has released in years.





Easy to build and simple to use. The OctoCam kit is ideal for those taking their first steps with the Raspberry Pi Zero W.



Using the suckers or the stand, the OctoCam can be placed anywhere you wish.

RASPBERRY PI DIY KIT

\$80 | PIMORONI.COM

Pimoroni OctoCam

A Raspberry Pi kit that would make George Orwell weep with frustration... but it can help you find out who's stealing the office milk!

The Raspberry Pi Zero W has been with us for over a year, and in that time, it has earned its reputation as a user-friendly and cost-effective platform. This has led to many companies assembling their own packs and bundles that create projects for learners to follow.

Pimoroni's OctoCam is a helpful cephalopod that features a Raspberry Pi Zero W, a small five-megapixel camera with a custom cable for the Zero W, and a laser-cut plastic frame. Also present are a USB lead for power, GPIO pins to solder and adapters to use the Zero W with an HDMI monitor and standard USB devices. All of the components are contained in a robust plastic case that will, of course, be reused to store all manner of screws!

Building the kit is remarkably easy and requires no tools. Simply insert the screws, connect

the camera and position everything behind the octopus. In the kit, there are four suckers used to attach the kit to a window so that the camera can be used to monitor your garden, pets or the fridge at work (obviously, don't record anyone without their consent). There's also a stand for positioning OctoCam on a desk.

No matter how you use the kit, you'll still have access to the GPIO, enabling the use of HAT boards and direct connection of components. Note, though, that you'll need to solder the GPIO yourself.

The SMP camera is a smaller version of the original Pi camera that offers HD video at 1080p, thanks to the Pi's on-board hardware decoder, at 30fps. If we reduce the res to 1,280 x 720, then we can squeeze in 60fps, which is enough for those wanting to capture death-defying stunts.

The camera can also capture images at a max

resolution of 2,592 x 1,944 pixels. Sadly, the camera is fixed focus, so anything less than 30cm away from the camera will be blurry. But for general use, the camera is superb. The camera is also compatible with Raspbian, and can be used with the raspivid and raspistill terminal commands, along with the picamera Python library.

As per the online instructions, Pimoroni recommends using the motionEye OS that will turn the setup into your own CCTV system. Doing this was simple thanks to the clear instructions and, within 30 minutes, we had our own CCTV system. This can be configured to react to motion, or to just simply record all video to a device.

For \$80, this kit is right on the money. The price of a Pi Zero W is around \$15 and the camera is about \$40. Add the cost of the accessories and some profit, and it's clear this kit is priced ready for family or

friends to purchase as a gift for birthdays, holidays or a home project. The kit doesn't include a micro SD card and a power supply, because it's assumed that the person will have these already. While this may be the case, if buying this as a gift, then it would be prudent to purchase any additional accessories.

This is a great kit that's simple to assemble. It serves as a fun introduction to what can be achieved with a Raspberry Pi Zero W in a short space of time. And it's a strong contender for your own camera-based projects.

■ Les Pounder

Verdict

Features
Performance
Value



A cost-effective kit that's simple to construct, and offers an interesting introduction to the Pi Zero W.





PC CASE

\$169 | WWW.CORSAIR.COM

Corsair Crystal 280X RGB

Corsair takes a stab at an RGB microATX cube.

The Crystal 280X is a much-needed update of the first and still impressive Carbide Air 240. Originally, the 240 was a shrunken variant of the Air 540 series, a compartmentalised cube, designed to allow for better temperature control and easier build access.

From the outset, the 280X takes the best of Corsair's Crystal series, and bakes it into a new variant of the fabled micro cube design. With added tempered glass now adorning the front panel, roof and side, there's no denying how classy it looks. Done badly, tempered glass can seriously restrict airflow, but Corsair has seemingly dodged this issue. The front panel is a solid single piece of glass and plastic; there's around 20mm of clearance between it and the front intake fans (covered by a magnetic dust filter). Turn your attention to the top, and a single pane of glass sits on a set of spacers, elevating it off the recessed dust filter, designed to provide plenty

of additional airflow for those exhaust fans you'll be installing in the roof.

Speaking of cooling, as standard, the 280X comes with two 120mm RGB fans, one mounted in the front, and one in the roof, connected to an RGB controller unit in the back of the case. As far as storage is concerned, that back compartment supports two 3.5-inch drives, accessible via a small honeycomb door located at the back of the case, near the rear I/O, with a further three 2.5-inch drive bays situated at the front. Aside from a full-size ATX power supply, you can also mount an additional 120mm fan on the rear side panel, too, presumably to draw cool air in to chill those 3.5-inch drives.

Spinning back around to the front compartment, where the majority of your hardware will be installed, there's room to support up to a 240mm radiator in the front, one on the floor and one in the roof.

At first glance, it all looks rather good – however, the Crystal 280X falls down on

two major points. In our opinion, this really should have been pitched as an ITX case. Install that small form factor motherboard into the 280X, and you can see there are plenty of rubber grommets in place to allow for your mobo cables to pass through anywhere you like easily enough. Opt for a microATX board, on the other hand, and what you're left with is a single rubber grommet cable pass-through situated on the bottom-right of your mobo.

There's nothing above it, because it's blocked off by the 2.5-inch drive caddy in the other compartment. There's no obvious cable routing solution, either. If you've got a microATX motherboard with a 24-pin port situated anywhere other than right in the middle, there's only one choice: Run it straight up from that bottom-right grommet – and it looks bad.

Then we have the dust filters. The ones located on the rear side panel and on the bottom of the chassis are fine; what you'd expect from a dust filter – securely

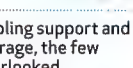
magnetised in place. The ones behind the tempered glass panels, however, only have large triangular magnetic pads on each corner, and two trapezium-shaped ones in the middle to help hold them down. It's not enough – they feel flimsy, and if placed incorrectly, can bubble up the mesh, ruining the premium feel.

It's a shame, because if it weren't for those gripes, there's a lot of neat features to keep us happy here. But that oversight on the 24-pin cable for microATX motherboards – in a case that's predominantly designed to be a microATX chassis – is just too much of a mistake for us to let go.

■ Zak Storey

Verdict

Features
Performance
Value



While it has strong cooling support and plenty of room for storage, the few caveats cannot be overlooked.



software

» APPS FOR ALL THE PLATFORMS



Windows SOFTWARE

Avanquest Audials One 2018

Taking you back to the days of home-made mixtapes.

\$59.90 | WWW.AVANQUEST.COM

Audials One is an affordably-priced program for streaming and recording audio from online radio stations. Covering music, podcasts and other broadcasts, it offers a wide variety of local Australian and international stations in its database.

While it's OK to record from radio stations for personal use in most countries, you have to be careful how you use it. In Australia, you can technically only use sound recordings for educational or research purposes and the copyright remains the ownership of the author.

The nature of Audials One — hunting for specific tracks and artists in a vast sea of stations — means it lives and dies by the quality of its search, and thankfully, it performs admirably. You can either download many songs immediately via sites like YouTube and Vimeo, or add them to a wishlist so Audials records them as soon as they're played on a radio station (which generally results in better audio quality). That wishlist lets you specify that you're looking for regular audio files, music videos or karaoke versions, and the app has customisable



download settings (including speed and number of downloads to run in parallel). It's an excellent system — just set up your lists, click Activate and leave Audials to do its thing.

Because it's based around radio stations, Audials One is also a great way to discover new music by artists who might have otherwise slipped under your radar. Listen to a track by one of your favourite performers, then see what else the station has to offer. Searching for an artist or song will also provide a list of stations that plays them regularly. You can browse stations by genre and location, which is a welcome touch, and when you select an artist, other performers will appear in a mind-map style diagram. The principle makes sense, but unfortunately the graphics don't look great and often don't scale well for different screen sizes.

There's a great built-in file converter that deals with all the most common audio and video types without issue, including special audiobook formats, which is a feature you don't see often enough.

All in all, Audials One has the potential to be great, but it's let down a little by an overly complicated interface that can be a bit of a barrier between you and the radio stations you want. Otherwise, it's excellent. **Cat Ellis**

draw.io Desktop

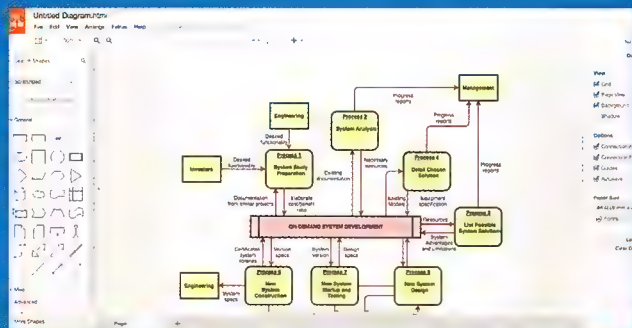
A free diagram creation tool that's better than many paid ones.

FREE | DRAW.IO

Let's say it upfront: draw.io is free. No, seriously. This diagram-creation tool is developed and maintained at no cost to the user. When you've recovered from that shock, you should know that it's an online solution that can save your work to Google Drive or Microsoft OneDrive.

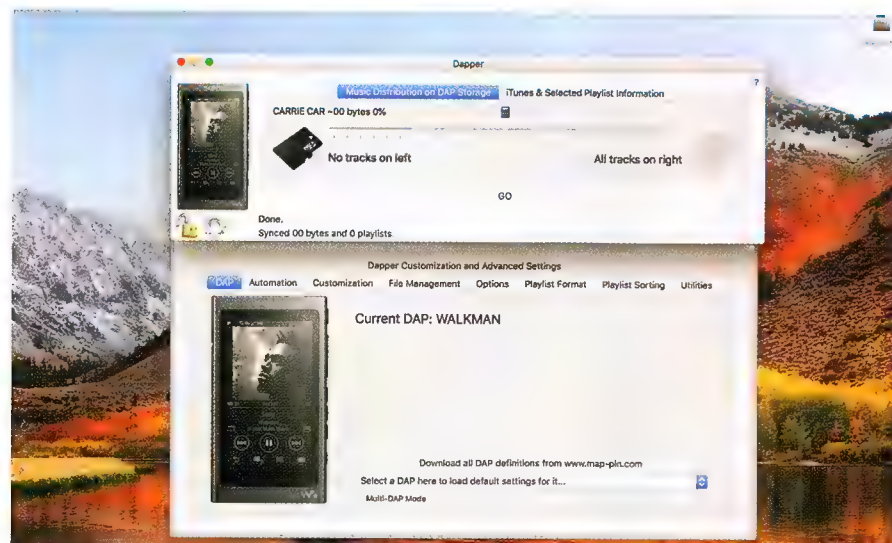
It can handle a wide range of schematics, including complex BPMN workflows, UML diagrams and general flowcharts, along with mind maps and network infrastructures. The list of possibilities is so big that it's impossible to include them all here.

So what is the catch? Well, if you use either Confluence or JIRA Cloud rather than Google Drive or Microsoft OneDrive, then you'll have to pay a subscription for cloud storage. But it's hardly expensive, costing US\$1 for Confluence per user per month.



Before you spend money on other solutions, it's worth checking out draw.io, if only to be amazed at what software tools you can get for free, and how good they can be. **Mark Pickavance**

Mac » APPS



Dapper

Move your iTunes music library on to any player.

\$30.99 | MAP-PIN.COM

If you've ever tried to export from iTunes to a non-Apple device, you'll be well aware of what an absolute pain it can be — especially if your library contains a variety of file formats beyond the ubiquitous MP3. Wouldn't it be great if an app could look at your iTunes library, convert it, organise it the way you want and get rid of any incompatibilities? That's exactly what Dapper delivers.

The easiest way to use Dapper is to create a playlist folder in iTunes called "Dapper". Any playlist you add to that folder will be synchronised with your device and the appropriate playlist files copied, too. You need to install a

second app to add the necessary converters and scripts, and you also need to go into iTunes' preferences to enable sharing of your iTunes library's XML data with other apps. But once you've done that, the process is simple. Just move the playlists you want to share in to your Dapper playlist folder, make sure the songs in those playlists are stored on your Mac, select your player and hit Go to sync.

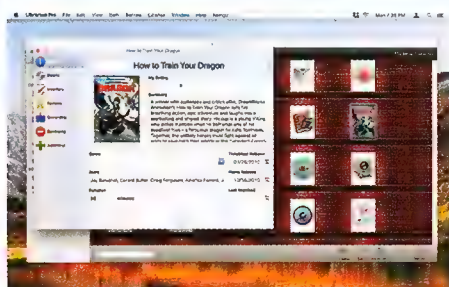
Dapper simplifies something that can be teeth-grindingly complex and sometimes utterly infuriating, and we'd particularly like to praise the customer support.

Carrie Marshall

Librarian Pro

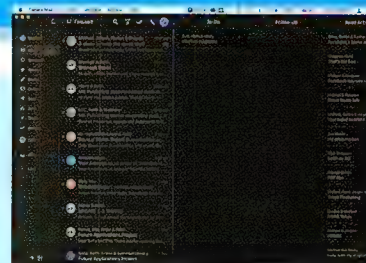
Get organised and track loans.

\$46.99 | KOINGOSW.COM



Librarian Pro is designed to allow you to keep track of your stuff — books, CDs, DVD, electronics and anything else you want to catalogue. Like its close competitor Delicious Library, its interface is built around the metaphor of bookshelves replete with skeumorphic wood grain. Sadly, in Librarian Pro, it's not done nearly as well as Delicious Library and doesn't have the latter's option to revert to a flat background.

Items can be added manually, by entering an ISBN or barcode and allowing Librarian to search the internet for details, or via a USB barcode scanner.



Canary Mail 2

Elegant, clever email client.

\$30.99 | CANARYMAIL.IO

Simple, secure, stunning. That's a bold claim by the developers of Canary Mail, an email app for Mac and iOS, but it does seem to stand up to scrutiny. Canary is a visually elegant email app in a straightforward three-pane style for the Mac version or a simpler swipe-driven design in iOS. The default appearance is dark with white text, and it shows a rotating selection of 'beautiful images' (as it calls them in its preferences) behind the message pane.

It is visually unusual but rather elegant, but it's not just a pretty face. The security features are easy and powerful, with one-click PGP for encrypted emails, although your recipients must support encryption to have this work. Its natural language search means you can search for 'invoices this year', for example, and it has an almost magical ability to filter out unimportant emails in its 'Focused' view. It shows when your emails have been read, helps with to-do and follow-up tracking, and it can snooze messages so they remind you at set points. It's slick and next-generation, it makes Apple's Mail app seem pedestrian, and we love it! Good looks and smart; Canary Mail is an attractive alternative email client.

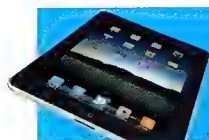
Keith Martin

An option to use your Mac's FaceTime camera is present but still in development — it didn't work when we tried it.

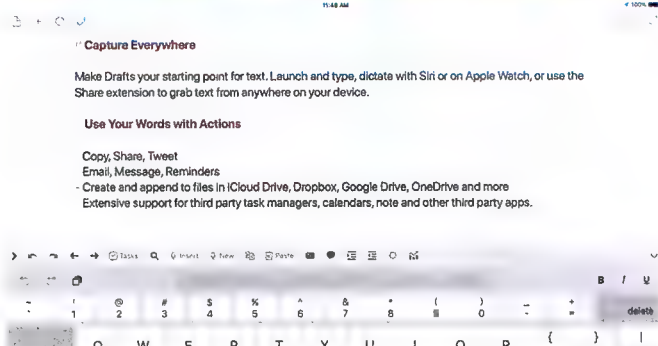
Other features include the ability to track loans and even issue late fees — you could start your own private lending library — and the option to add purchase and sale details.

Librarian Pro works well enough and has enough features to satisfy ardent cataloguers, but it doesn't look anywhere near as good as Delicious Library. It is cheaper, though.

Kenny Hemphill ■



App Store » iOS APPS



Drafts 5

A powerful, versatile text-editing app.

FREE WITH IAP | GETDRAFTS.COM



Most apps serve an obvious, single-minded purpose and attempt to do that one thing better than the competition. Then there's Drafts, which looks like any other note-taking app on the surface but does oh so much more.

While it's not expressly designed for long-form writing, Drafts 5 is certainly capable of that, and for capturing a quick thought, making a to-do list, or jotting down ideas. Despite being the equivalent of a Swiss Army knife for text, Drafts 5 is as drop-dead simple to use as it gets: Launch the app and a cursor awaits, prompting you to begin typing.

It's what you do with this text once entered that makes Drafts so unique. The app provides customisable actions and scripts capable of transforming snippets into new emails, social media posts, messages, events, Evernote entries, or to be repurposed in other apps. Once you start using Drafts, you'll wonder how you lived without it.

With the release of Drafts 5, you no longer have an excuse not to try — the entirely new app is free, with an optional Pro subscription (\$2.99 monthly or \$27.99 annually after a seven-day trial), which unlocks advanced features like themes, custom icons, editing actions, and more. The free version also comes with an updated editor, Siri integration, tappable task check marks, and improvements to the awesome arrange mode, which enables you to reorganise lines or blocks of text via drag and drop.

Our favourite new feature is tags; rather than organise content by folders, Drafts 5 enables you to add custom tags to notes, making it a snap to find something later, even after accumulating hundreds or thousands of different text snippets. You can do this in bulk by first selecting multiple notes, then applying the proper operation.

Also notable is how Drafts 5 integrates with SiriKit; in other apps, Siri stops listening after about 45 seconds, but the developers have circumvented this limitation, so you are now able to dictate for minutes at a time. Considering all the potential input methods, it's surprising to find there's no direct import, particularly from Apple Notes, but this is a small quibble, since notes can be shared easily enough without styling. This really is the best text editing app you never knew you needed.

JR Bookwalter

Things 3.6

An update to get more things done.

\$14.99 | CULTURECODE.COM



Things 3 sports a fresh look since we last saw it back in issue 445, but this isn't the task manager's only change. There are now time-based reminders; you've always been able to schedule tasks, but now you can specify a time to be reminded to do them. And it supports both natural language and Siri. Other additions include an Upcoming list (rather than just Next), category headings, and checklists.

A new Magic Plus button enables you to create items precisely where you want them in a list, add them straight to your inbox from anywhere, or create headings.

You can edit multiple tasks at once, and reorder them by dragging. You can link to tasks, enabling you to jump to them quickly from within Things, or even from other apps, which enables automated workflows.

Things syncs between your Mac and iOS devices using Things Cloud, which has a new Fastlane mode for time-based reminders. Note, that the iPad version is \$30.99; on Mac it's \$79.99.

Things is very intuitive. It rewards a few minutes' tapping and swiping with an array of options. Version 3.6 also adds full hardware keyboard support on iPad — great for productivity when your Mac isn't around. It's a pleasure to use, which hasn't always been the case.

Kenny Hemphill

Manything

Free home security with old iOS devices.

FREE WITH IAP | MANYTHING.COM



Manything ("monitor anything") transforms spare devices into home security cameras. As long as your devices run iOS 8.0 or later and has a working camera, you're in business. (The app can be used on older devices running iOS 6 or iOS 7, but only if you install on a newer device first.) Getting started is a snap: Register for an account from the first device (this can only be done within the app), then choose whether that hardware will be used as a Viewer or Camera. Repeat the process by installing the app on a second device and logging in with the same credentials. Then you're ready to tap the red button on the Camera device, and a few seconds later, the live stream appears on the Viewer device.

The app is free but limited to live streaming from a single camera. That's enough for infrequent use or for parents with a newborn child, for example, but subscription plans (available direct or via iTunes) add cloud recording from \$5.99 per month for one camera.

We were impressed by the breadth of its capabilities. Standalone security camera systems are equipped with features like motion or sound detection and alerts, and these are available here as well. You can adjust video streaming quality, with separate options for Wi-Fi and cellular.

Detection offers 10 levels of sensitivity with the option to set up specific zones to monitor, while alerts can be sent via push notification, email, or both. The only real limitation is that the app tends to be a battery hog. JR Bookwalter ■



Google Play » ANDROID



Looks like ... a tree?



Google Lens

Google's AI lets you learn on the go.

FREE | TINYURL.COM/APC457-LENS



Using a device's camera and Google's AI, the user hovers their camera over an object, prompting the app to generate a series of 'points of interest' on the phone's screen. Once one of these are tapped, Google will find corresponding results in its search engine.

For example, hovering the cam over our bottle of Mount Franklin, the app was able to detect that a bottle of water was, indeed, what it was looking at, allowing us to read more about it. We were able to scan its barcode and bring up a price. Similarly, we were able to scan a privet in our front garden and discover that, yes, it was a privet, with Lens offering a handful of different privet examples (as an aside, deciduous trees don't bring up many results when they're without foliage).

Scan the cover of a book and you'll find reviews and information about it; scan a business card and you'll be able to add all the details on it into your Contacts list. Similarly, scanning anything that is immediately identifiable – say, artwork or a landmark – will deliver results worth perusing.

Unfortunately, with the version of Lens we used, it wasn't yet possible to scan and copy text. Similarly, we'd like to be able to have the app translate foreign text, and while it could do this with individual words, these words only came up as possible search results. To have a whole sentence translated will hopefully come in future updates. **Shaun Prescott**

Smarter Time

The moments that make up a full day.

FREE | WWW.SMARTERTIME.COM

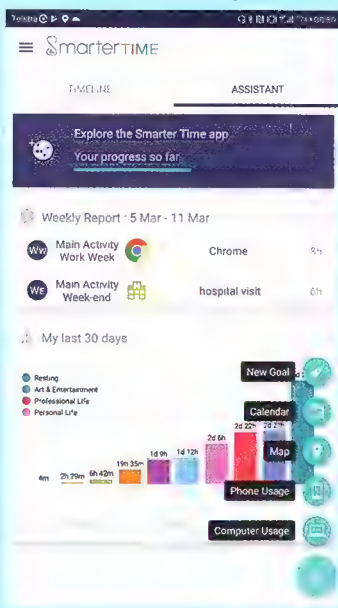


Smarter Time categorises every waking and sleeping minute into chunks and displays the results in an easy-to-read chart. The app uses location services and monitors your app usage

in conjunction with your phone's accelerometer and other sensors to record what you do. It purports to work in the background and automatically guess what you're doing.

Visit a cafe and it'll be logged in your time line, or go for a walk with your phone and that will be logged, too. Same goes for time spent on apps, browsing the web and so on.

When it gets it right, it can be startling to see just how much time you spend on certain activities. However, it's prone to misreporting and is a battery vampire. This writer apparently spent barely 22 hours asleep over seven days, and had over 100 hours uncategorised. Anyone who's diligent can go back and correct these anomalies, but it's irritating spending time counting how you spent your time...! **Paul Taylor**



BandLab

Immediately participate in a creative community.

FREE | BLOG.BANDLAB.COM



BandLab is a one-stop shop for collaborative and mobile music creation, coupled with a social media platform that doesn't suck. Its approach is delightfully lightweight and intuitive, despite how comprehensive its tools are. At its core, the app appears to revolve around a fairly typical array of social functions such as the ability to follow other users, check out their feeds and discover new users and artists by genre, popularity and more, but the significant difference here is that these users are actually of use to you. BandLab hosts a variety of powerful recording, writing and arranging tools for music creation and, once you've built your track or sketch, you can upload the files for others to crack open and edit themselves. This translates to an entire of community of musicians that are uploading jams and ideas, laying down vocal takes over someone else's beats, or remixing a blues song to sound like an ambient chillout track. The mix editor is where you lay out all your instruments and recordings in a linear fashion in order to form a song, and anyone familiar with a computer digital audio workstation will feel right at home here. This is also the area where you can add notes or lyrics to your project, set the BPM, time signature, key and other such useful settings. For your selection of tracks, you can either import your own audio, use one of the available instruments or record something directly via your device's mic. Each track comes with its own specialities, and every instrument has the ability to add effects like a nice reverb or filthy fuzz. Overall, the level of control you have over your song arrangement is just enough to grapple with a complex structure, and just shy of being too convoluted for a mobile app. BandLab is a no-brainer for no dollars. **Harry Domanski**



Linux » OPEN-SOURCE SOFTWARE

LxQt

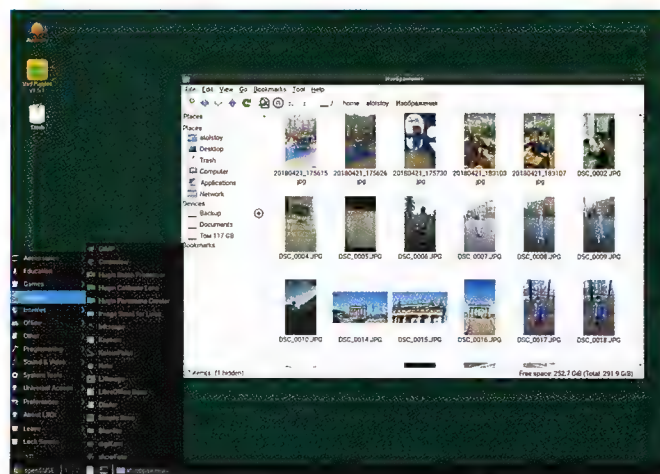
A desktop environment both new and familiar.

FREE | LXQT.ORG

We often say that freedom of choice is the cornerstone of open-source software, and it's particularly true when it comes to choosing a lightweight desktop environment. This entry is for those Linux users who own a low-end computer or just don't want to waste their computing power on unnecessary visual fripperies.

LxQt is a decent alternative to the traditional standoff between Plasma and Gnome, but we strongly believe that LxQt has the potential to lure away some MATE users as well. The secret to its success doesn't lie solely in its speed and lightweight nature, as you might expect, but rather in the fact that LxQt also maintains great UI consistency. That helps it to build a neat and pro-looking desktop of your own using native Qt-based apps. This makes a difference because it's something that's currently hard to achieve if you decide to go with GTK or Electron-based apps, for instance.

There's a reason why we're paying so much attention to the developing LxQt ecosystem. Apart from third-party programs that will slot in nicely into LxQt's architecture (such as Notepadqq), there's a plethora of components that evolve under the LxQt umbrella as standalone applications. To be more specific, the new LxQt 0.13 includes the QPS process explorer and the Screengrab tool, and nothing prevents you from using these tools outside LxQt as well.



As for the rest, the new desktop features some improvements in the libfm-qt and liblxqt libraries, and in Qtterminal. For an end user, it means faster loading times in the PCManFM file manager, better display handling in multi-monitor setups and more adequate tab design in the Terminal program.

What makes us happy is LxQt's innate sense of elegance. It feels as though you're working within a well-thought out, integrated environment — not a set of standalone apps that someone just piled into a big ol' heap. It'll definitely takes a bit of time and patience to fine-tune LxQt so that it meets your specific requirements, and it may be more complicated than what you usually do, say, in KDE, but your efforts will certainly be worth the time spent.

LxQt is moving in the right direction. The future version 1.0 has already been announced and it should work fine with Wayland. Good times lie ahead. **Alexander Tolstoy**

Krusader

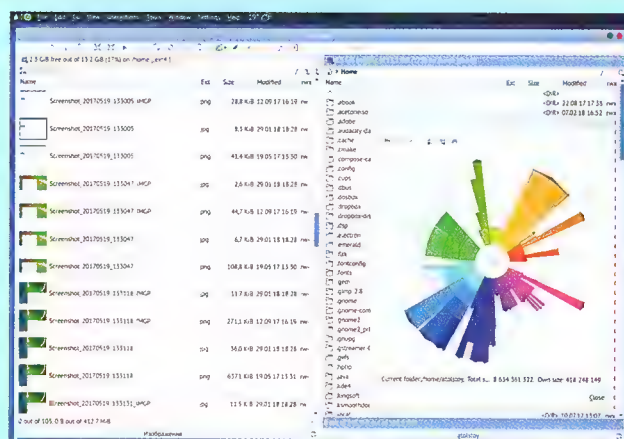
Get a grip on your files with this manager.

FREE | WWW.KRUSADER.ORG

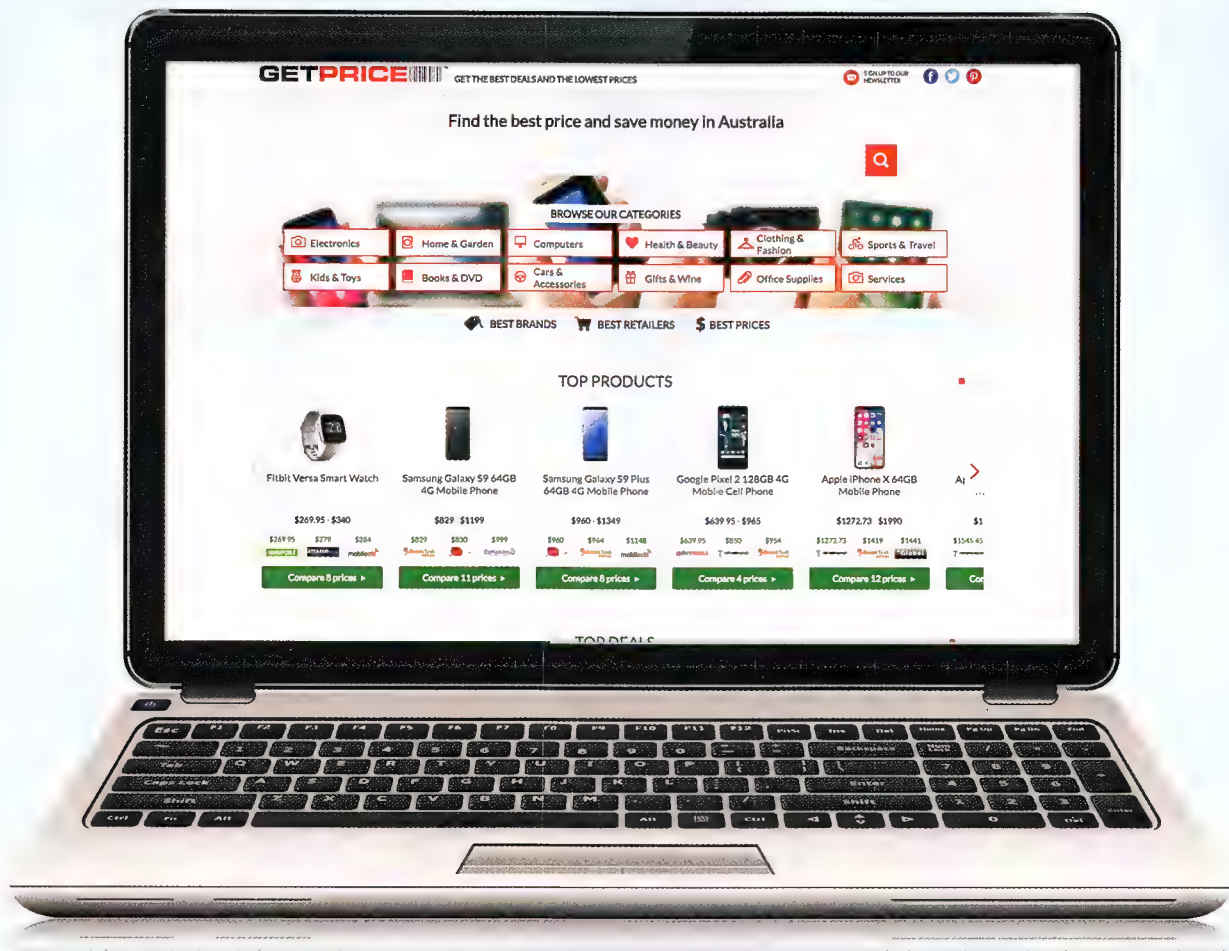
The good old twin-panel approach isn't going to disappear anytime soon, and we're happy to see that Krusader file manager keeps on evolving. This is the type of utility that manages to squeeze lots of features into one solution, and even though you can always, say, press F3 in Dolphin to bring up the double panel layout, you can't display as many great features that are present in Krusader.

The idea is to boost your productivity with a tool that prevents you from moving away to other apps or windows, by providing everything you need. It goes far beyond copying or moving files between two directories on display. When you first launch Krusader, it checks for third-party applications that it can use. Furthermore, it informs you when it's found a tool for running the `diff` command, a mail client, a batch rename tool, an MD5 sum calculator, support libraries for various archive formats and so on.

It'll take some time to discover the numerous extra features in Krusader. You can get a lot of extra information without even clicking anywhere — just hover your mouse pointer over a directory to see its properties in the pop-up box. The application has its own mount manager (MountMan), which can create disk usage charts and enables you to filter



the list of mount points with removable devices only. Krusader has fixed over 40 bugs and brought in key improvements since we last looked at it. You soon notice these once you spend some time with the program and let it help you with daily tasks. This is the most straightforward way to discover the new bookmark quick search feature, tab pinning, as well as enjoy a better thumbnails look and more accurate handling of MIME file type icons. **Alexander Tolstoy**



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ON TOP OF YOUR GAME

A new category of Wi-Fi routers promise to give you flawless online gaming, but do they deliver? Bennett Ring tests eight new models to find out.

Wi-Fi might be one of Australia's proudest technological creations (thanks, CSIRO!), but we all know how flaky it can be even under the best circumstances. Unfortunately, not everybody can lay Ethernet cable through their home or use Ethernet-over-powerline kits, so Wi-Fi is often the only available option.

Thankfully, the technology has improved massively over the last few years, but there are still some huge caveats and misunderstandings about the technology. The biggest marketing mistruth is the speed that today's Wi-Fi routers are capable of, with many claiming combined speeds of over 5,000Mbps.

This is usually designated on the box as a speed beginning with the term "AC [insert speed here]". For example, the ASUS RoG Rapture GT-AC5300 claims to have a top speed of 5,300Mbps, but closer examination reveals that this isn't quite true. Sure, the router can pump out that theoretical maximum speed, but not to a single device. Instead, it uses a single 2.4GHz network to push out 1,000Mbps, with another two 5GHz networks, each delivering 2,167Mbps. Add the three together, and you have the end result of 5,300Mbps, hence the 'AC5300' in the title.

This extra bandwidth definitely comes in handy if you're connecting a stack of different devices to your Wi-Fi network, but no single device

can utilise all of that bandwidth, as there's the issue of the numbers of transmitting and receiving antennae. Most of today's high-speed routers use a 4x4 configuration, which means they have four transmitting and receiving antennae. However, most laptops, tablets and smartphones only have a 2x2 configuration, which means they can only achieve at most half the speed of each channel. And they can only connect to one channel at a time. Again, if you're loading up several devices onto the same channel the extra antennae will be of benefit, but if you're only hooking up a couple of devices that extra bandwidth won't get used.

There are lots of terms being bandied about regarding the latest in today's Wi-Fi routers, but arguably the most important is MIMO. This allows multiple devices to connect at a higher speed to a single frequency than routers that don't feature this tech. Unlike a year ago when many devices claimed to be MIMO compatible* (*pending a firmware update at some indeterminate date in the future),

2.4GHz vs 5GHz

While 5GHz networks are advertised as having higher speeds, they don't perform as well over distance when compared to 2.4GHz. This is why you'll often see that the 5GHz performance at range is similar, or even less than, the 2.4GHz networks. It's worth trying both when setting up devices that are distant from the router.

LABS TEST RESULTS: GAMING ROUTERS

	ROUTER MODEL	ASUS ROG RAPTURE GT-AC5300	D-LINK DSL-2885A	D-LINK TAIWAN AC3200 DSL-4320L	LINKSYS WRT32X	NETGEAR NIGHTHAWK XR500-100AUS	NETGEAR NIGHTHAWK X4S D7800	SYNOLOGY RT2600AC	TP-LINK AC4000 ARCHER C4000
PING TEST RESULTS (LOWER IS BETTER)	PING UNDER LOAD (MS)	20	36	23	20	20	22	24	24
	PING NO LOAD (MS)	20	24	22	19	19	21	20	21
	PACKET LOSS UNDER LOAD	0	4%	0	0	0	0	0	0
2.4GHZ SPEED TEST RESULTS (HIGHER IS BETTER)	2.4GHZ DOWN CLOSE (MBPS)	46.14	65.45	81.6	74.55	86.2	37.76	57.14	46.37
	2.4GHZ UP CLOSE (MBPS)	33.14	34.54	58.21	29.69	40.29	31.56	36.28	35.46
	2.4GHZ DOWN FAR (MBPS)	44.92	23.9	31.98	6.45	55.53	29.78	35.37	41.77
	2.4GHZ UP FAR (MBPS)	30.31	12	53.09	19.28	48	20.95	34.32	34.96
5GHZ SPEED TEST RESULTS (HIGHER IS BETTER)	5GHZ DOWN CLOSE (MBPS)	241.25	175.42	210.96	211.41	230.65	228.81	237.24	213.57
	5GHZ UP CLOSE (MBPS)	77.96	56.09	68.76	68.74	72.35	79.52	67.75	58.13
	5GHZ DOWN FAR (MBPS)	128.05	96.79	142.44	168.87	156.78	138.76	112.55	89.3
	5GHZ UP FAR (MBPS)	76.47	15.65	74.36	64.56	82.83	63.42	46.31	69.46

TESTING NOTES

Ping testing was performed using CS:GO, with both PCs connected to router via Ethernet; laptop was downloading a 5GB file via Dropbox, while gaming client ran CS:GO and played a 4K YouTube demo video. **Wi-Fi speed testing** was performed using LAN Speed Test app, using a 1GB test file. Close range was approx 1.5 metres, long range was approx 10 metres, with two half-concrete walls in between router and client. Each Wi-Fi file transfer test was repeated three times and then averaged. All routers had the most current firmware available installed at time of testing.

today's routers actually are MIMO-ready.

The other buzzword is QoS, or Quality of Service. This allows the router to look at the different forms of traffic being passed through the router, and then prioritise them based on their needs. Generally speaking, gaming traffic is given the number one priority, then streaming video, and then everything else. Nearly every premium router these days features QoS, but some do it automatically while others require the user to configure which PC on their network gets the most network love.

We tested eight of the latest premium routers on the market for several things. Firstly, how did they perform during gaming when under load and not under load; for the former, we ran a 5GB download file on a laptop connected to the router via Ethernet, while also running CS:GO and a 4K YouTube video on the client PC. From here, we could use CS:GO's detailed network performance monitor to see the difference QoS makes, measuring both the ping to the server, as well as the packet loss. As you'll see, the performance difference isn't huge, but this is largely in part because we tested using an Optus Fibre to the Home connection, tested at 95Mbps down and 34Mbps up.

"Nearly every premium router these days features QoS, but some do it automatically while others require the user to configure which PC on their network gets the most network love."

Secondly, we tested the file transfer performance on both the 2.4GHz and 5GHz networks at both near and far range, by transferring a 1GB file using the LAN Speed Test application. We should point out that, since the April update of Windows, simply sharing a folder between two PCs hasn't been documented well. It took us six hours and two laptops to get it working; firstly, the removal of workgroups from Windows 10 means that both machines must log in to the same Microsoft account, using the same authentication method – one machine using a PIN can't share with another using a password. Secondly, we simply could not get our Windows 10 desktop to share a folder with our Windows 8.1 laptop, so had to swap the latter out for a Windows 10 laptop. Note that this laptop was equipped with an 802.11ac Wi-Fi module using

a 2x2 radio, which is basically the norm these days, and explains why the speeds tested are well below the advertised rate of the router's maximum.

While our results show that most of the routers were pretty evenly matched, the fact that we only used two devices at a time on each router means that those with higher overall AC ratings will perform better if you're using many more devices. This is definitely something to consider if you've got a house of four or more people, all using laptops or smart devices, where that extra bandwidth will actually be used.

We should also point out that we tested in a residential area, where interference from other networks and even microwaves or garage remote controls can lower overall performance.



8 x antennae; AC5300; 1 x 2.4GHz
+ 2 x 5GHz networks; 8 x Ethernet

\$598 | WWW.ASUS.COM.AU

ASUS RoG Rapture GT-AC5300

The king of gaming routers.

Delving into the incredibly detailed interface of this router shows just how far ASUS has pushed the boundaries when it comes to gaming routers. It's the most expensive router in the roundup, but also features so much more than the competition. There's a cornucopia of different menus dedicated solely to gaming that are totally absent compared to other routers, and we're not just referring to QoS.

If you're willing to pay a small monthly subscription, you can use the dedicated Gamer's Private Network, which will optimise your network hops between you and your chosen server. The QoS technology is based on TrendMicro algorithms, and delivered some of the best test results when it came to gaming under load. There's a huge eight Ethernet ports, along with eight dedicated antennae, which can all be rotated through almost 360° for optimal aiming. It even includes a built-in site

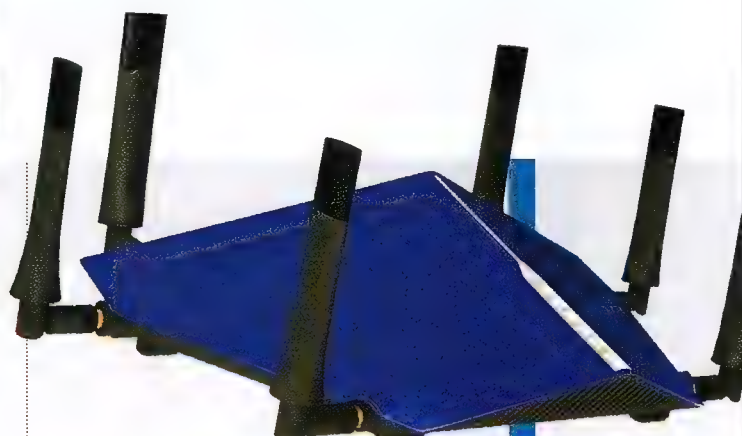
survey tool, showing you where other networks are intruding.

When it came to Wi-Fi transfer speeds, this router basically wiped the floor with the competition. We can only imagine the speeds possible if you had a 4x4 media bridge to make the most of the 4x4 config used here. If you're a network pro, there's a massive amount of settings that can be tweaked to get even better performance than the default out-of-the-box speeds, though most users will be more than happy with it as is.

If you don't mind spending \$100 more, this is the ultimate gaming router, and is also perfect for properties that need maximum range to multiple devices.

Verdict

The best overall consumer router on the market. But she sure isn't cheap...



6 x antennae; AC3200; 1 x 2.4GHz
+ 2 x 5GHz networks; 4 x Ethernet

\$499 | WWW.DLINK.COM.AU

D-Link Taipan DSL-4320L

Disappointing for the dollars involved.

At just \$100 less than the champion ASUS router, left, we expected the Taipan to bite into the ASUS's performance, but sadly, no. The total bandwidth offered by this router is 3,200Mbps, with a single 2.4GHz 600Mbps and twin 5GHz 1,300Mbps networks, well below that offered by the ASUS.

Even just picking up this router gives an indication that there's not much to it – it may look huge, but it's extremely lightweight, suggesting the interior isn't chock full of hardware. Six antennae power the 4x4 radio, but it only has four Ethernet ports. On the plus side, it does include an ADSL/VDSL modem, unlike the ASUS, which requires an external modem.

For this price, we expected extremely deep levels of customisation, but the bare interface is hardly any different from budget D-Link models, with hardly any features to speak of. It's also extremely buggy,

taking several SSID changes and reboots before we could get the 2.4GHz network to connect. Even then, the performance was initially slow, but rebooting again tripled the results. This left the performance in the top tiers of the roundup, though it was still up to 30% slower than the ASUS in some tests. The QoS section requires the user to manually set each device to a priority level, which is simple enough but limits one PC to having the lion's share of the bandwidth; too bad if you have multiple gaming machines running at once.

At \$500, we expected more. Despite excellent performance figures, it lacks the features and deep customisation of similarly priced units.

Verdict

The Taipan used to be the ruler of the snake pit, but newer routers have knocked it out of the park.





4 x antennae; AC3200; 1 x 2.4GHz
+ 1 x 5GHz networks; 4 x Ethernet

\$349 | WWW.LINKSYS.COM

Linksys WRT32X

This mid-range model still has some quirks to iron out.

Showing up at the very last minute, the new WRT32X is Linksys' attempt to take on the gaming market. While it has some great potential, the firmware is in dire need of some love and attention to maximise its potential.

Even setting this up proved to be troublesome — while most routers are simply plug and play, it took several attempts before we could get the Ethernet ports to connect, even though the Wi-Fi worked straight out of the box.

This is a dual-band router, so only delivers 3,200Mbps of bandwidth, yet our far range 2.4GHz performance numbers were truly abysmal. The other results were fine, suggesting this is a bug in the firmware. It's got Killer networking technology built in that prioritises gaming traffic and lowers pings, especially if you're connecting it to a Killer-equipped PC. Our test PC just happened to be using the Killer E2500 LAN port,

and the results speak for themselves, with this router delivering the best gaming performance of the lot. Yet the ability to tweak the QoS settings are totally absent, other than being able to prioritise a certain PC on the network. Where this router did shine was the 5GHz long-range test, posting the best result in the roundup, at 169Mbps, though its other results weren't quite so stellar.

There's definitely the potential for this affordable router to shine, but Linksys needs to get to work on fixing some of the show-stopping bugs. When they do, this will become a rather potent gaming router for those with a handful of devices and a priority on the lowest pings possible.

Verdict

Ping performance is brilliant, but a few weird bugs stop this from being a suitable plus-and-play unit.



4 x antennae; AC2600; 1 x 2.4GHz
+ 1 x 5GHz networks; 4 x Ethernet

\$399 | WWW.NETGEAR.COM.AU

Netgear Nighthawk X4S D7800

Knocked out by Netgear's other gaming Nighthawk.

As just \$30 cheaper than the newer Nighthawk XR500-100AUS, it wouldn't be too much to expect this router to perform on par with its cousin. Yet there's a huge difference in speeds between the two, especially at long range.

The total bandwidth offered by this router is 2,600Mbps (800Mbps + 1,733Mbps), and it comes with an integrated ADSL/VDSL modem, which could account for the price hike compared to its superior Nighthawk, which requires an additional modem. It automatically detected our NBN connection and even installing the most recent firmware without us having to do a thing. We did notice some weirdness with the QoS, though; the user has to manually set the upload and download speed of the internet connection, yet after saving this, the values were way off what we'd entered. It didn't hurt gaming performance,

though, with this router scoring in the middle.

We appreciated the twin USB ports, allowing for external storage to turn it into a NAS or print server, though at this price range, this is quite a common feature. There's also support for Netgear's ReadyCloud, allowing you to retrieve files from the external drives remotely. The unit allows for extremely tailored radio settings, though there's only one application featured, a built-in Torrent downloading client.

While it does have a built-in ADSL/VDSL modem, the long-range file transfer speeds aren't up to snuff. It's great for close-range speeds, not your entire abode.

Verdict

This router starts to fall apart when transmitting over longer distances.





4 x antennae; AC2600; 1 x 2.4GHz
+ 1 x 5GHz networks; 4 x Ethernet

\$429 | WWW.NETGEAR.COM.AU

Netgear Nighthawk XR500-100AUS

Extreme speeds at a great price.

Unlike its sibling, you're going to need an external modem to make the most of this router. However, if you do happen to be hooking this up to an NBN modem, get set to be blown away by arguably the best overall performance of the lot. It didn't take out the No.1 spot in every test, but on average, it was the best at file transferring to a small number of devices, which isn't too shabby considering it's \$160 cheaper than the ASUS. This is probably because it's only an AC2600 unit, meaning it'll only handle a small number of devices before network congestion becomes an issue.

The other trade-off is a lack of dedicated gaming features. It's built around the DUMA OS, which is absolutely brilliant. The first time we visited the dashboard, an automatic tutorial explained every section, so we knew exactly where to go to fiddle with the QoS settings. These are

mostly automatic, though, lacking the granularity of other models that can prioritise different types of traffic. Heading into the advanced Wi-Fi options reveals an ocean of settings that can be tinkered with. We still managed to get excellent speed results with the default ones. Best of all, we didn't experience a single hitch with any of the configurations. Gaming performance was also exceptional, with the best pings of the bunch.

While it may not have the bandwidth to handle a dozen different laptops, smartphones and PCs, this is an excellent router for those who want peak performance out of a small number of network-attached devices.

Verdict

It's not in the same league as the ASUS, but it's cheaper, and delivers just as good gaming performance.



4 x antennae; AC2600; 1 x 2.4GHz
+ 1 x 5GHz networks; 4 x Ethernet

\$345 | WWW.SYNOLOGY.COM

Synology RT2600AC

It's all about the add-ons.

If there's one thing we love about this AC2600 router, it's the added-extras. Logging into the main dashboard reveals the Synology Router Manager (SRM) interface. You can drag and drop various windows, so you can monitor performance in one, while tweaking Wi-Fi settings in another.

It also has one killer feature in that it supports the installation of various software packages that extend the functionality of the router, including VPN clients, media servers, anti-virus scanners and more.

There's enough depth in the settings to allow semi-experienced networkers to adjust things without bugging everything up. The QoS functionality is a little simple, which is probably why it had one of the higher pings while under load, but when it came to file transfer speeds, we couldn't complain at this price. It doesn't include an ADSL/VDSL modem, though,

helping to keep the cost down. It's also only packing four Ethernet ports alongside the WAN port, though it does support link aggregation if you've got a PC that has dual Ethernet ports that also support this technology. Having said that, this feature is basically the norm for any router over the \$300 price point. A nice touch is the ability to patch in twin Internet connections, so if one fails, the other automatically takes over, which could be a must if you need 100% uptime.

Provided you don't overload the 2,600Mbps total bandwidth, this is an excellent performer, and the addition of software packages gives it a unique edge that the others lack.

Verdict

The ability to load extra packages to open up the functionality makes this a commendable router.





6 x antennae; AC4000; 1 x 2.4GHz
+ 2 x 5GHz networks; 4 x Ethernet

\$399 | WWW.TP-LINK.COM

TP-Link AC4000 Archer C4000

Suffers from performance drops.

Every router in our roundup had a default IP of 192.168.1.1... with the exception of this one. Defaulting to 192.168.0.1, this minor pain in the posterior goes against the grain of most of today's Wi-Fi enabled devices, which all use the 192.168.1.1 to 254 range. As a result, we had to change the default router IP out of the box, as the rest of our devices in the network all defaulted to the usual network range.

One feature we do love is the fact that the six antennae don't need to be screwed in; they simply flip out from the top of the router. These deliver two 5GHz networks at 1,625Mbps each, along with a single 2.4GHz network of 750Mbps, for a total of AC4000. Delving into the interface reveals a clean yet detailed layout, with the core pieces of network information displayed on the main dashboard. We especially like the QoS

section, which allows you to prioritise different forms of traffic, be it gaming, streaming, VOIP and more.

Unfortunately the gaming setting didn't seem to perform as well as the rest, hitting 24ms under load, roughly 25% higher than the best routers in the roundup.

The biggest issue, though, was that of speeds, with this \$400 router hitting long-range speeds of around half of that of some of its similarly priced competitors. On the flipside, it does have three bands delivering 4,000Mbps, so will handle more devices better than AC2600 models. Still, at this price, we expected much better long-range performance.

Verdict

Underwhelming speed results at long range make this a rather overpriced option.



3 x antennae; AC1200; 1 x 2.4GHz
+ 1 x 5GHz networks; 4 x Ethernet

\$179 | WWW.DLINK.COM.AU

D-Link DSL-2885A

A look at what the standard end of town can deliver...

We decided to include this more-standard router as a nice counterpart to the much more expensive routers on offer. At only \$179, including an ADSL/VDSL modem, it's a very affordable entry-point for those who need a basic Wi-Fi network. Having said that, there's obviously been some serious compromises made to hit this price point.

To begin with, the total output of this router is just AC1200; less than quarter of the fastest in the roundup. But hey, some people only need to hook up a PC, phone and laptop, in which case, this is more than enough, especially if you're relying on ADSL rather than NBN. It will still work with the NBN, but you'll be flooding the router with more traffic than it can handle.

The interface is just as basic as its much more expensive big brother, with very sparse customisation options and features. It doesn't even feature QoS,

which is why it performed so poorly in our gaming test. In fact, it was the only router that experienced any packet loss, at 4%. In a game of CS:GO, that could be all the difference between your bullet registering on the server or not.

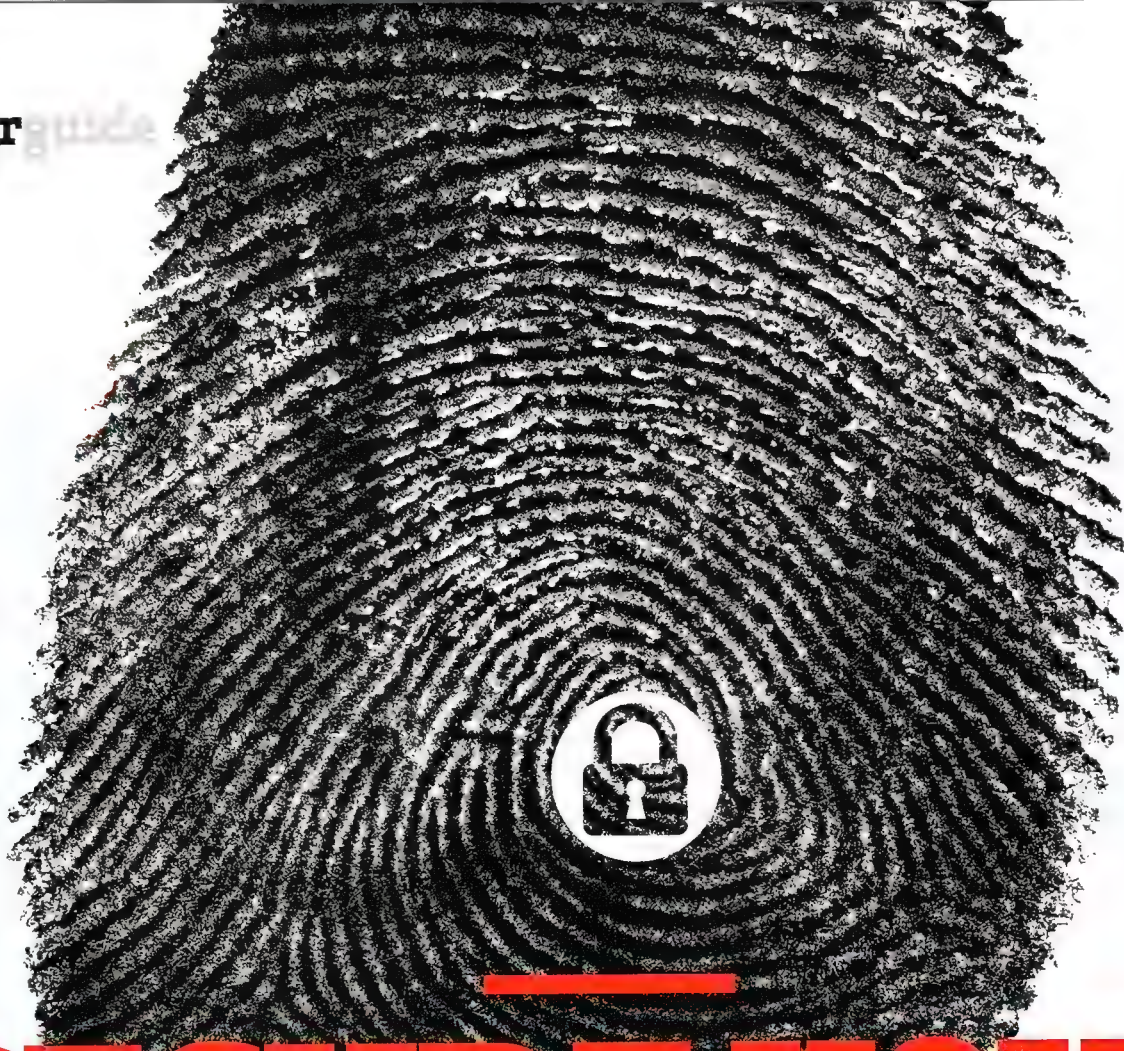
At least it's easy enough to set up and run; just take it out of the box, plug it in and follow the three-step setup tutorial and you're good to go. However, you'll then see just how slow it is, with truly abysmal long-range 2.4GHz speeds.

And yet they're just right if you're using a single device with ADSL, where the 24Mbps download speed at range is right on the cusp of the theoretical maximum of today's copper network. ■

Verdict

It's good enough for those running ADSL2+ who don't want to spend a packet.





SECURE YOUR DIGITAL LIFE

THE COMPLETE 2018 GUIDE TO PROTECTING ALL
YOUR DEVICES & ONLINE ACCOUNTS

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SAFER WEB SURFING

Add these essential add-ons to Microsoft Edge, Chrome or Firefox to give you the ultimate protection when online.

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**SUPER-SECURE
PASSWORDS MADE EASY**

Human laziness, complacency, general failings and unending ingenuity to subvert systems have undermined passwords forever. It's time to next-gen your security, and save all your passwords.

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**PROTECT YOURSELF
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Having a security suite installed is more important than ever. We take a look at our current favourite security suites for your PC.

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Worried about your old data? We offer a permanent solution with this free utility.

Safer web surfing

Add these essential add-ons to Microsoft Edge, Chrome or Firefox to give you the ultimate protection when online.

The web can be a dangerous place, full of ransomware, adware, viruses and other nasties – and that means your browsing habits, and your privacy, can be put at risk.

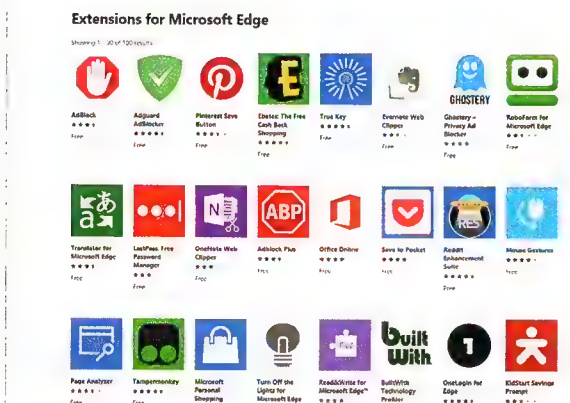
While having an antivirus program helps – say, Windows 10's own built-in Windows Defender tool, or a third-party

piece of software such as Norton Antivirus – there are also a number of add-ons (also called extensions) that can be added to your web browser to give you extra protection. These add-ons are lightweight tools that run from within your browser, which means they don't need to be installed separately. This helps saves

drive space, and ensures that your PC won't get slowed down either.

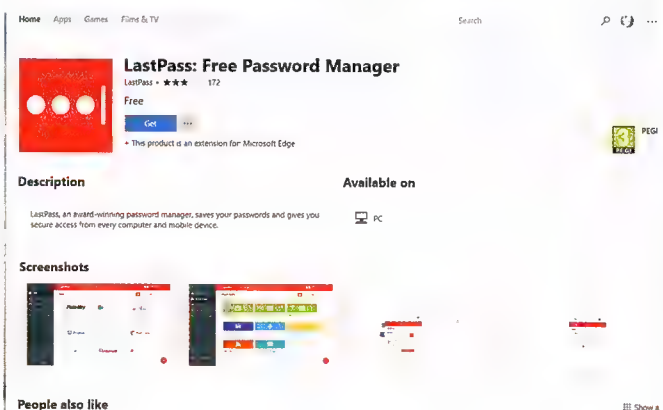
The three most popular web browsers are Google's Chrome, Mozilla's Firefox and, of course, Microsoft Edge, the default option if you're using Windows 10. In this step-by-step guide, we'll look at the best security add-ons for each one.

Make your browser more secure



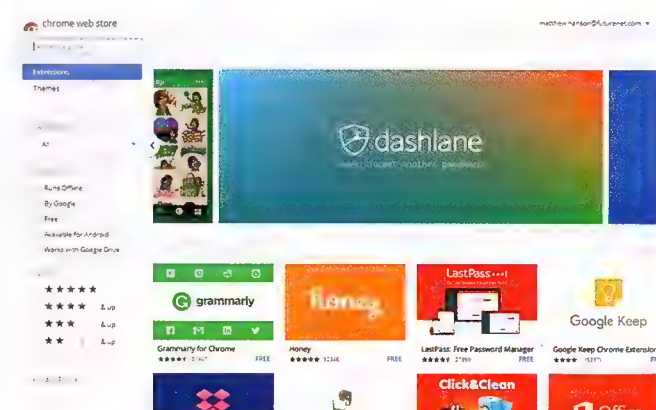
1 ADD EXTENSIONS TO EDGE

If you're using Microsoft Edge, head to www.microsoft.com/en-au/store/collections/edgeextensions/pc to see a range of extensions. To install one, click on the icon of the extension you want. Then click 'Get the app'. The extension will then be added to Edge. You may need to restart Edge for the extension to load. You can also use the Microsoft Store app in Windows 10 to do this.



2 INSTALL GHOSTERY

Ghostery is a very useful extension for Edge. It blocks ads, and while this makes websites load faster, it is also a good security measure, since some online ads contain malware. This extension also blocks trackers on websites that collect data on you, and it can anonymise your data to further protect your privacy. Ghostery is also available for Firefox and Chrome.

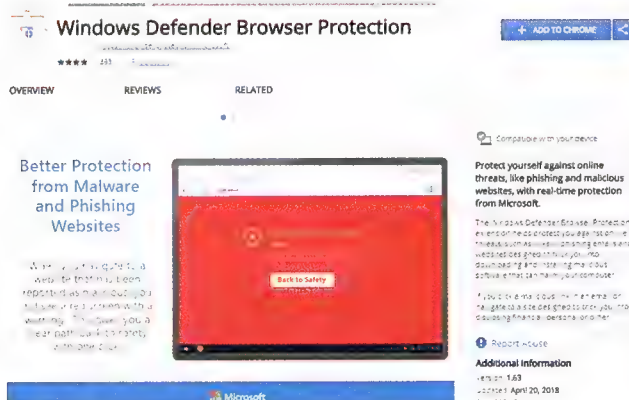


3 CREATE STRONGER PASSWORDS

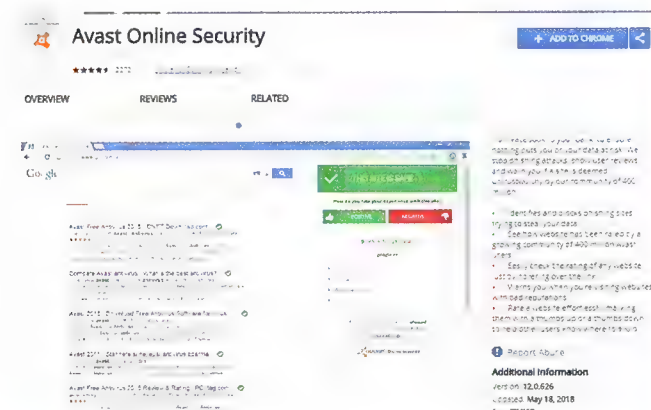
LastPass is a password manager that can securely store all your passwords for various websites, and enables you to log in via Edge on a number of different devices. This extension helps protect your security since you can use it to create unique, difficult-to-guess passwords for each site you visit without having to remember them. It's available for Firefox and Chrome, too.

4 ADDING EXTENSIONS TO CHROME

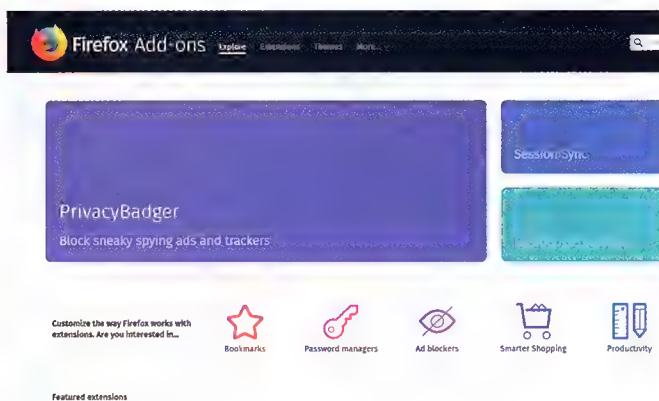
Chrome is the world's most popular web browser, and for good reason – it's fast, reliable and supports extensions, which you can download from the Google Webstore (chrome.google.com/webstore). From there, you can search for the extension you want. Click the icon and it will give you more information about it. Next, click 'Add to Chrome'.



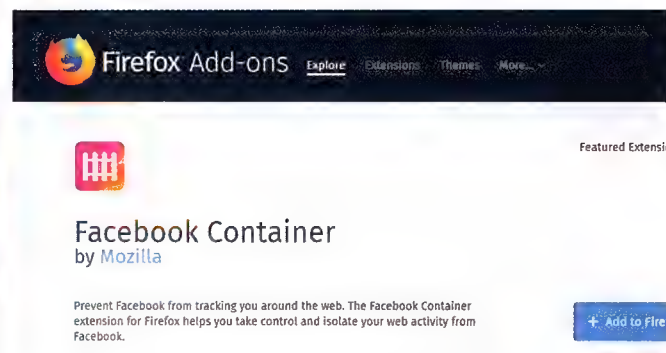
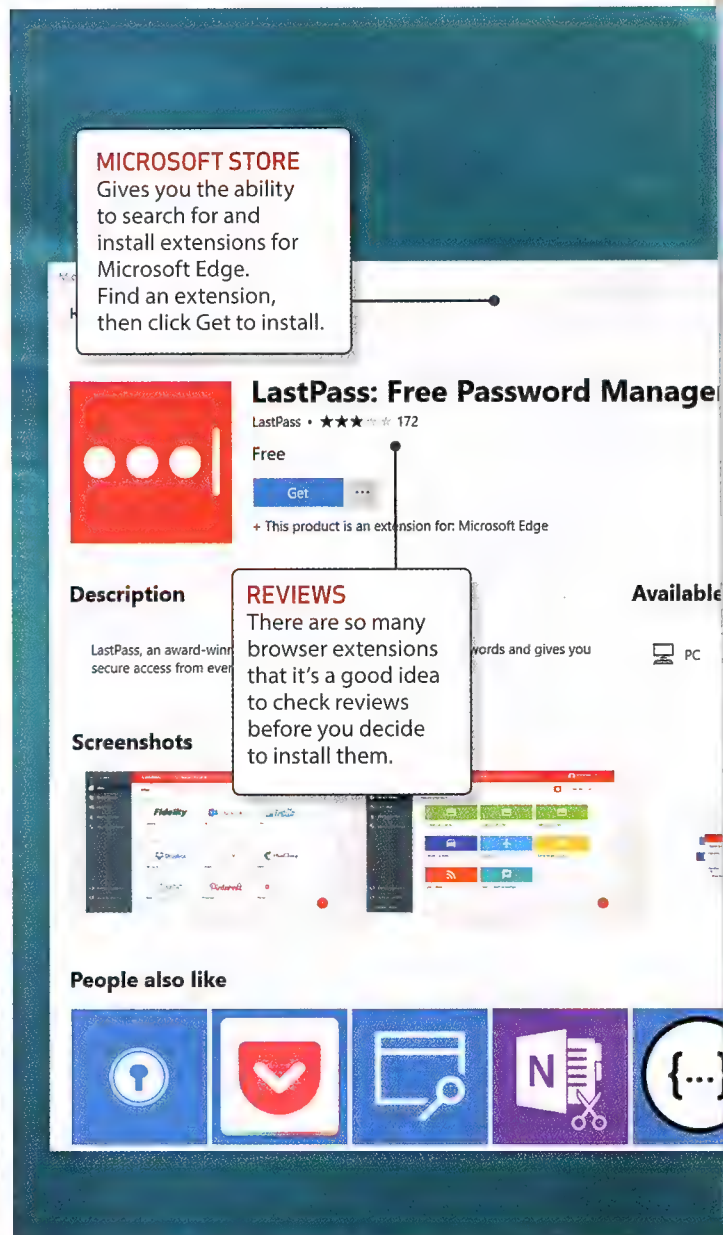
5 WINDOWS DEFENDER BROWSER PROTECTION This extension from Microsoft helps improve the security of Google Chrome. According to Microsoft, the Windows Defender extension for Chrome (available from the Google Webstore) catches 99% of phishing attacks, while Chrome, without the extension, only catches 87%. If you're impressed with how Windows Defender works in Windows 10, this is worth installing.



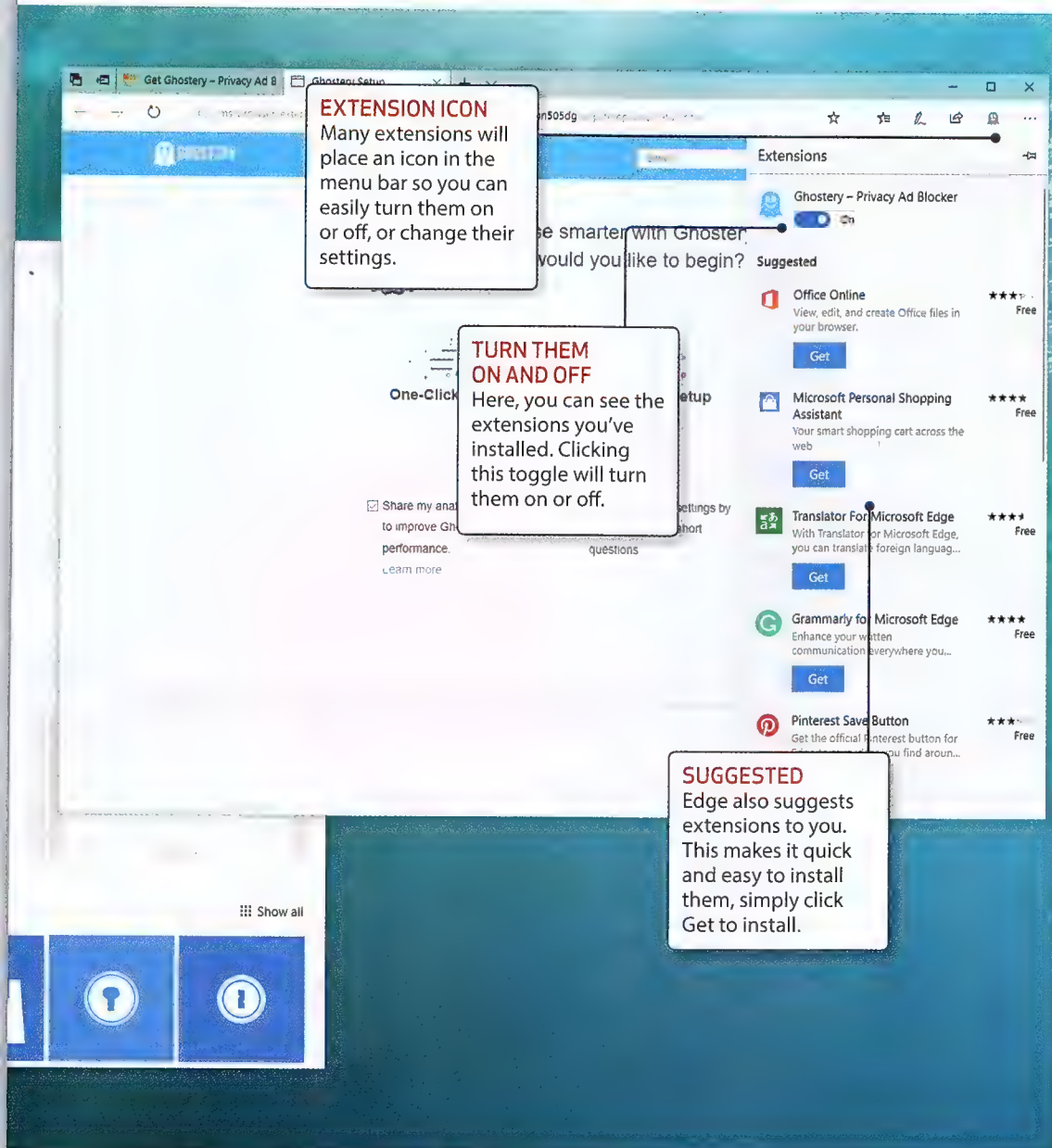
6 AVAST ONLINE SECURITY Avast is another well-known name in online security, which has provided a free extension for Chrome and Firefox. It identifies and blocks phishing sites, and uses its community of 400 million users to help identify threats. This makes the Avast add-on a very useful tool for protecting your PC. It will warn you if you attempt to visit to a site with a bad reputation, and you can rate sites, too.



7 INSTALL ADD-ONS IN FIREFOX Firefox is another popular web browser, and like Edge and Chrome, you can install extensions to help boost your security when browsing the web. Head to addons.mozilla.org to find the range of add-ons for Firefox. Click on the icon of the add-on you want while running Firefox, then click 'Add to Firefox'. You will then be able to access the newly-installed add-on.



8 FACEBOOK CONTAINER Facebook has been in the news lately, with many people concerned about how much info it collects from you — even if you're not on the site. Mozilla has created an add-on (addons.mozilla.org/en-US/firefox/addon/facebook-container) that isolates your Facebook identity in a separate, window, so the social network can't track you when you visit other websites.



JARGON BUSTER

Extension

Extensions, also known as add-ons, are small bits of software that add features to an already-installed app, like a web browser.

Web browser

Web browsers are pieces of software that let you access the internet. As they are your main tool for browsing the web, they need to have strong security features to help protect you.

Phishing

Phishing is a scam where a malicious site or user pretends to be a trustworthy brand, such as a bank or online store, in an attempt to get you to reveal data, such as passwords.

Web Security

by Web Security

Web Security actively protects you from malware, tampered websites or phishing sites that aim to steal your personal data.

+ Add to Firefox

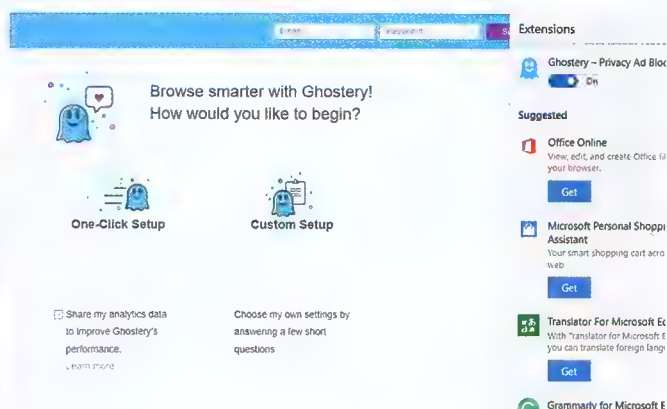
Rate your experience

How are you enjoying your experience with Web Security?

Log in to rate this extension

Report this add-on for abuse

Screenshots



9 WEB SECURITY

An add-on that does exactly what it says on the tin. Web Security (addons.mozilla.org/en-US/firefox/addon/web-security) uses an extensive database to block websites that are known to contain malware or try to obtain your data. This add-on is only available for Firefox, so be wary of other extensions for Chrome that have the same name.

10 MANAGING YOUR ADD-ONS

Installing add-ons and extensions is easy, but what happens if you want to remove them, or change their settings? The process differs depending on which browser you are using. If you're using Edge, click the ellipsis (...) and select Extensions. In Chrome, click the three vertical dots, then click 'More Tools > Extensions'. In Firefox, press 'Ctrl-Shift-A' on your keyboard. ■

Super-secure passwords made easy

Human laziness, complacency, general failings and unending ingenuity to subvert systems have undermined passwords forever. It's time to next-gen your security, and save all your passwords, says Neil Mohr.

In any system, humans will find a way to subvert the rules for their own gain. It's a recurring theme: from skipping class, cheating in games, fixing the banking system, and exploiting welfare, down to stealing from work, and gambling in Vegas. So it shouldn't be a surprise that most humans choose the lazy option when it comes to password security, as well.

It's too easy just to say humans are lazy, and pin terrible password security on that. Humans will always attempt

to game systems at both ends, which is why passwords are being hacked and people want to avoid memorising them in the first place. It's not good enough to just use a strong password; we now live in a world where so much is tied up with our online lives that hackers are doing more and more to break into online accounts.

So we're going to look at the whole subject of password security, and hence online account security, how we can choose better passwords, how we can make our lives easier but also safer,

how we can increase protection beyond passwords, and how hackers attack and use your account details.

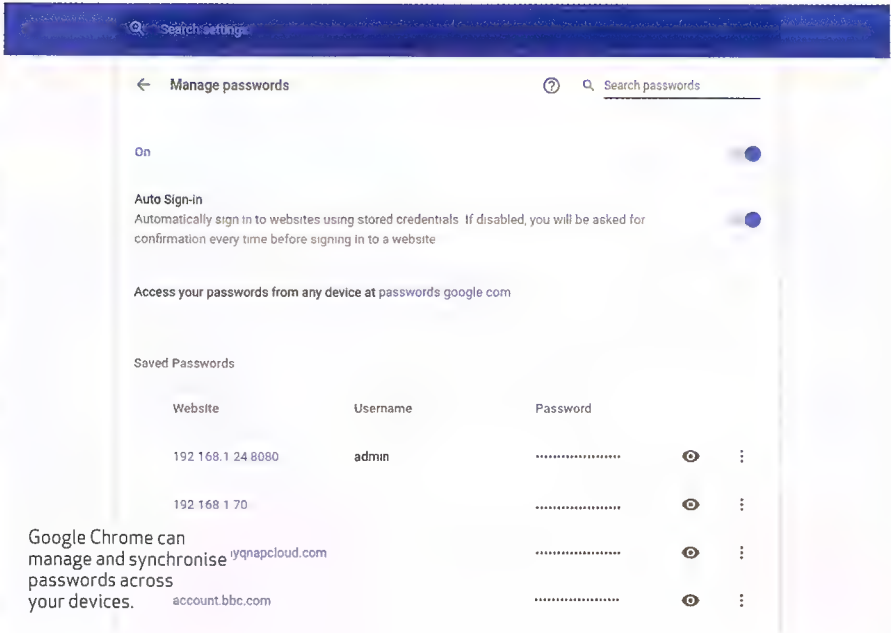
Some of this advice you'll have probably heard before, some of it is hopefully new, but by the end, you'll be suitably terrified that you'll overcome your human propensity for laziness, and get up off your arse, and protect your passwords!

Let's start by scaring the trousers off you. There has been a host of research on password security, made much easier by the huge number of database breaches in recent years. One of the widest-ranging research efforts was by Google, published mid-2017 in its 'Data breaches, phishing, or malware? Understanding the risks of stolen credentials' paper (research.google.com/pubs/pub46437.html).

Some sweet nuggets from that little cache include the fact that the researchers swept over 1.9 billion non-unique account usernames and password credentials. These were taken from a variety of leak sources, but mostly blackhat security forums. An insane 76% of these could be (or already were) easily converted to plain text (best practice is to hash and salt stored credentials). The researchers were able to reverse an impressive 36% of hashed passwords, using a suitable keyword attack.

Of those stolen via phishing attacks, 49% were from Americans (with only 1.8% being from Australia). When it came to pure security leaks, 39% of credentials were linked to Americans. As for credentials stolen via keyloggers, Americans were targets in 8% of incidents; Brazil accounted for the highest amount in this group at 18%.

Credential leaks appear to happen regularly these days. The largest ever remains the initially hushed-up Yahoo leak, back in 2013, in which pretty much every Yahoo account ever was leaked, totaling 3 billion. Adult Friend Finder topped 412 million, the 2017



Equifax breach hit 143 million Americans, while MySpace, Adobe, LinkedIn, Dropbox, LastFM, NexusMods and many more have all had their leaks, each individually releasing millions of users' details.

These leaks show the basic issue with password reuse: If you are using the same password across all of your online accounts, it just takes a single leak to contain that password, and all your accounts are compromised.

SCIENCE, SAVE US!

So the logical next question is: What makes a secure password? Entropy. That means the level of randomness in a system. By randomness, we mean true randomness. It's not enough to have a long password, it has to be long and truly random. We stumbled across a lovely analysis of poor passwords by WPENGINE, at wpengine.com/unmasked.

Among many things, it shows that password creation is a truly gender neutral pursuit – men and women can live equally in a world with terrible passwords. It's worth a read – as well as being funny and interesting, it highlights a lot of general failings of humans when it comes to creating passwords.

The obvious beginnings are the standard bad passwords: "123456" and any variation thereof, "password", "qwerty" and again any variation of those. Obvious stuff. Another issue is that many password guidelines are bad – forcing upper-case letters, for instance, because people tend to just capitalise the first letter; forcing at least one number, because people just put "1" at the end; or demanding a password of at least a certain length, because people use a pattern on the keyboard. For example, the seemingly random "ADGJMPTW" is actually

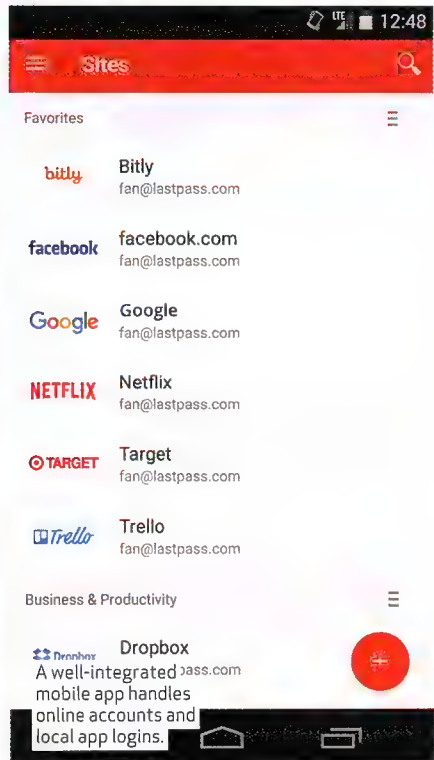
people typing 2-9 on a smartphone number pad. This is what happens; it doesn't make for strong passwords, because they're easier to guess with a much lower entropy.

It's that human nature thing. One group wants to protect a system, another wants an easy life, so it circumvents the rules, a third group is attempting to break in. So how do we make stronger passwords?

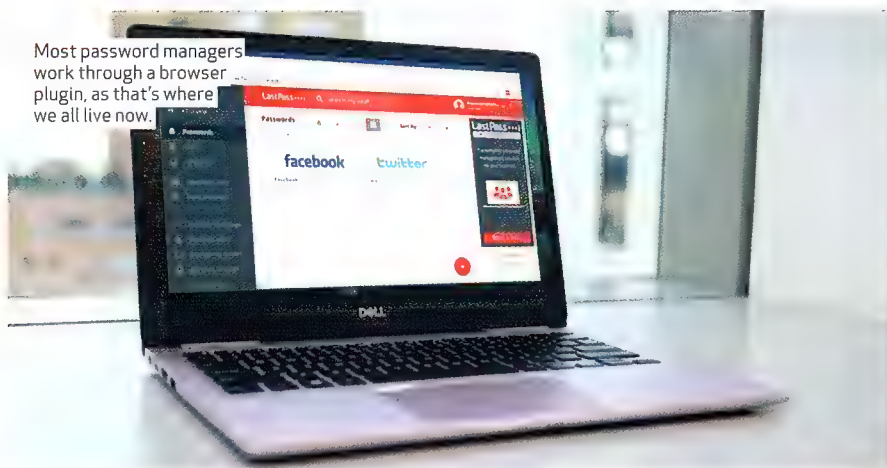
A few years ago, a Dropbox engineer, Dan Wheeler, wrote a blog post (tinyurl.com/apc457-wheeler) referencing Randall Munroe's classic XKCD correcthorsebatterystaple cartoon (xkcd.com/936) on password entropy, alongside Mark Burnett's earlier research (tinyurl.com/apc457-burnett). Dan's post is long and complex, and focuses on what makes a strong (high entropy) password, alongside how that can be easily measured and communicated to the user. Conversely, Randall's point was part password strength, but he was largely extolling the need to make password systems human-friendly.

We don't want to get into the nitty-gritty too much, but effectively a good password is a long password. Simple. The XKCD approach is to use a memorable series of words or phrase, usually painting an odd scene, such as the classic example of a "correct horse battery staple", but it could be a phrase such as "basketball on a unicycle flying high". From a memorable point of view, this taps into techniques used by memory experts. Of course, throw in some numerals and symbols, and it's even stronger.

None of this addresses the core issue, though, that we now have a seemingly endless number of online services to use and try, each with their own password and login. Even making



Most password managers work through a browser plugin, as that's where we all live now.



"Chrome's basic but smart enough password manager means that as long as you're logged in to your Google account, a right-click in a password field offers the option to generate a secure password."

passwords memorable wouldn't solve the innate issue of having to remember them all. The solution to that is a password manager.

MICROSOFT, SAVE US!

The obvious place to start is to ask what tools Microsoft provides in

Windows 10 or beyond. The blasé answer is 'none'. Windows doesn't come with any specific password management tool. What Microsoft has done is build a basic password manager into its Edge browser, which enables those saved passwords to be synchronised across your Windows

accounts, and to any other instances of the Edge browser you might be running — Edge on Android, for example. But what if you're not on your Windows account? What if you're not on Windows at all? What if you're using Chrome or Firefox? What if you want to create a strong password? What if a site is demanding non-standard credentials? The Edge password manager is basic at best, and fails to help in all but the most simple of scenarios.

BROWSERS, SAVE US!

How about a browser that you might actually want to use? The most widely used browser at the moment is Google Chrome, and it comes with a reasonable password manager built in. To kick off, if you've logged in with your Google account, it syncs passwords across all of your devices and operating systems (Windows, macOS, Linux, Chrome OS), and is, of course, available on Android and iOS devices, too. Google also offers an online service at passwords.google.com that enables you to log in and access passwords from within any browser on any device.

Beyond passwords, Chrome also supports intelligent form filling. You can enter a default address, phone number and email address, and if Chrome thinks you're filling those details in, it offers to try to auto-fill entire forms or individual elements. Alongside this, it has a secure credit card storage option,

The open-source way

We like open source, even if it doesn't always produce the most polished-looking software (cough, GIMP, cough).

But for security software, its publicly scrutinisable code tends to provide peace of mind, while largely ensuring a project can continue even if the original organisation or developer packs up their bags, as the source code stays open to be picked up by someone else.

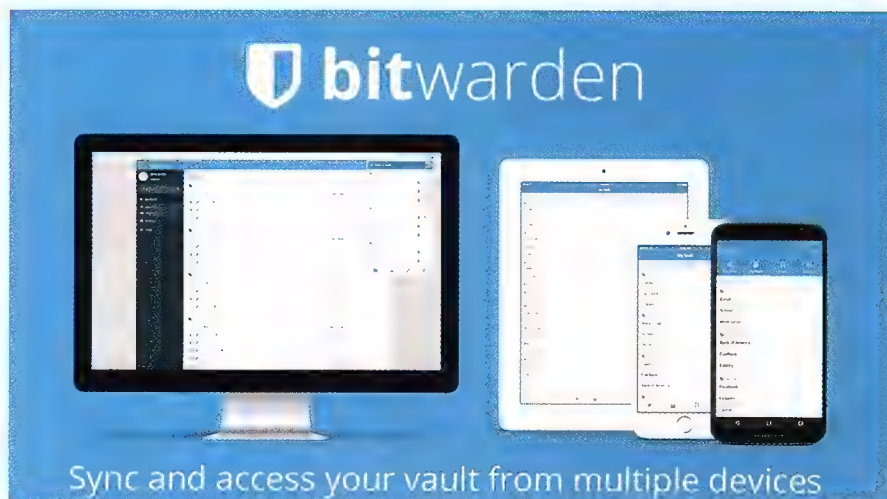
We're going to highlight two strong open-source candidates. The first is the well-known [KeePass.info](https://keepass.info). Don't confuse this with the largely defunct [KeePassX.org](https://keepassx.org) that hasn't been updated for two years. There is a fork called [KeePassXC.org](https://keepassxc.org), which is up to date, but we'll stick with KeePass as it has many unofficial respins for Android and other devices that make it easier to use.

KeePass isn't as straightforward as the commercial alternatives; the main hoop you need to jump through is for multi-

device synchronisation, where a third-party cloud service, such as Dropbox or Google Drive, needs to be roped in. But the breadth of support, custom options and feature set is unmatched, with no fees to pay.

The other strong open-source option is Bitwarden. It offers an excellent free model, a US\$1-a-month family

subscription that supports up to five users, a basic business version at US\$5 per month, plus enterprise options. It's a modern, slick, open-source application supporting macOS, Windows, Linux, all the major browsers — including Opera, Tor, and Brave — plus Android and iOS devices. If you're a fan of open source, we suggest you give it a look.



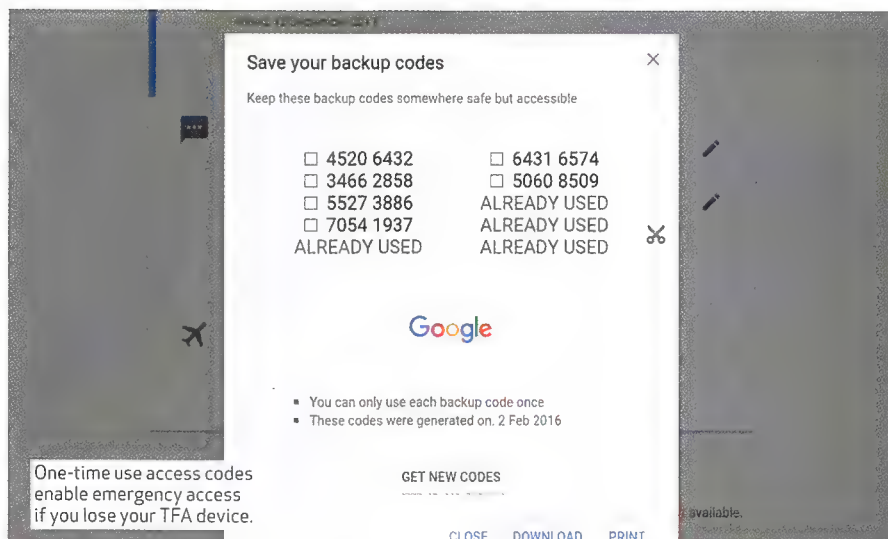
if you find the idea of Google having your credit card details a good one... What could go wrong?

Chrome's basic but smart enough password manager means that, as long as you're logged in to your Google account, a right-click in a password field offers the option to generate a secure password. There are no options, it just provides a random password of suitable length. It then, of course, saves and manages that login and password for you. You can set exceptions and manage the saved passwords from within the Advanced Settings. Access to these is protected via a system prompt to enter your Windows password.

The other main browser worth a mention is Mozilla Firefox, although it doesn't provide much more functionality than Microsoft Edge. It synchronises your password across its own Firefox account to any supported OS or devices. It doesn't support forms, won't generate passwords for you, but does offer an independent master password to protect access.

LASTPASS. SAVE US!

So browsers generally leave us wanting more when it comes to real password management. You could get by with Google Chrome, but we can do better. Enter the world of dedicated password managers. We're going to concentrate on LastPass in this main section – for alternatives, see the various boxes



throughout the feature. It's certainly one of the prime options to look at when it comes picking a password manager; the free account provides the majority of the basic functions people require, while the paid-for premium edition is just US\$2 per month.

LastPass is a multi-device, multi-OS, multi-browser tool. It largely works as a browser plugin for the big five: Chrome, Firefox, Safari, Edge/Internet Explorer and Opera. It runs on all the main desktop OSes: Windows, macOS, Linux and OpenBSD. And for mobile devices, there's Android, iOS and Windows Phone support. Plus, you can log in to your LastPass password vault through any browser, too.

The name LastPass comes from the fact that your LastPass account password will be the last password you need to remember; it'll take care of all the rest. So what does it do? The main use is via a browser plugin and apps on your mobile devices. As you create new accounts or log in to existing ones, LastPass stores your usernames and passwords, or offers to generate new passwords as accounts are created.

The LastPass password generator is pretty sweet. You can choose any length, up to 100 characters, select any mix of upper and lower-case, choose the quantity of numbers to use, and decide if it should use symbols. There are also advanced options for

Authenticate with Google

We're going to highlight the Google Authenticator as a prime TFA tool.

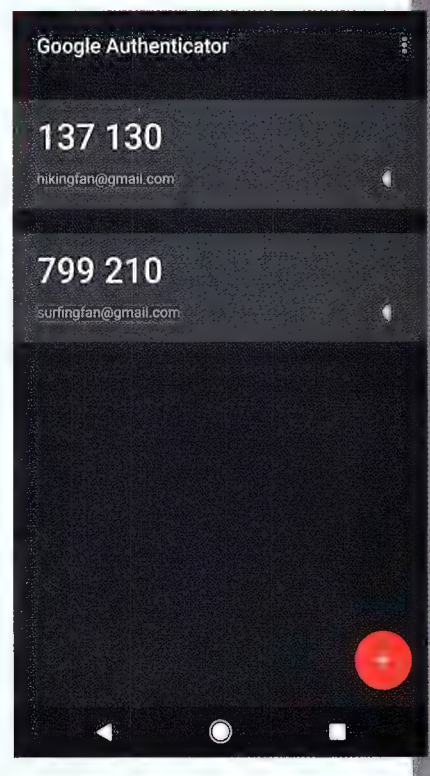
Install it on your phone, then fire up the service you want to protect with TFA. LastPass uses Google Authenticator (among others) to do so. Using that as an example, head to 'LastPass Vault > Account Settings > Multifactor options'. Click the Edit button and enable it. Use the Barcode option to display a QR code. On your phone, open Google Authenticator, tap the + and click 'Scan barcode', then point your phone at the on-screen QR code. LastPass has now been added to Google Authenticator.

Any time someone tries to access your LastPass Vault from a new device, they must enter the current code (this updates every 30 seconds) before access is granted. There's an option to allow access for 30 days, before another TFA prompt appears on that device, so it's not too annoying. Without your phone, there's no access.

TFA is great, but does have a couple of provisos. Firstly, the service using it mustn't be monumentally stupid.

It was discovered that some services could have TFA circumvented by simply calling up and providing some basic personal information, making the use of TFA more security theatre than actual security. The second is that potentially the TFA code is locked to the one phone. Technically, a rooted Android device enables you to transfer the Google Authenticator secrets, but if you get a new phone, ensure you disable TFA on your services, before wiping your old one. Otherwise, you could be locked out of vital services. LastPass keeps the QR code secret, so you can have it on multiple devices, and transfer it later on — as long as you can log in.

Because of the magical nature of cryptography math, many services also offer offline access options, usually via a bank of single-use passcodes that you can print or scribble down, and keep safe somewhere. It means if your phone is stolen or broken, you can still access accounts.



avoiding ambiguous symbols or attempting to make it pronounceable.

Accounts can be grouped into categories and searched. You can add notes and opt for automatic logins, to help speed you into accounts. LastPass also supports automatic filling of standard forms: names, addresses, emails, phone numbers, bank accounts, credit cards and custom fields. There's a general encrypted notes tool, too. It also offers a warning for insecure forms, plus a security audit of existing accounts that you might import from your browser. Two-factor authentication is supported, too (we'll cover this later). The paid-for service expands password filling to other applications, on both Android and Windows — LastPass can fill in a program's password and fields; handy these days as more programs require some type of login for subscriptions.

Once installed, it's worth looking at the Preferences. We like to add a log-out time, so if you leave your PC alone, it logs itself out after an hour, for example.

LastPass isn't the only password manager to offer all these features, but it does provide an idea of the expanded capabilities, improved security, and genuine ease of use a dedicated service offers.

But with great power, comes great responsibility. A service like LastPass requires you to use a strong master password; if that is hacked, someone will gain access to every service you use. Or if you forget the password, LastPass can't restore your master password, as it is never sent it in the first place, as a deliberate security measure. It might sound like we're putting all our eggs in one basket, but what do you want — an individual

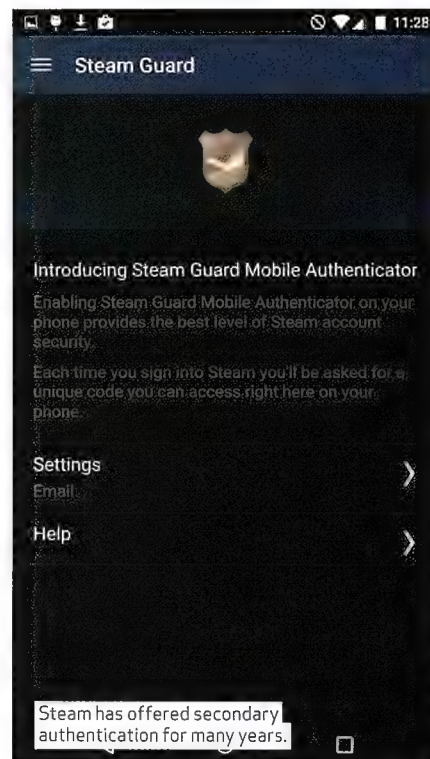
basket for every egg, or just one awesomely secure basket?

Even security conscious businesses can be hacked and run into issues (en.wikipedia.org/wiki/LastPass#Security_issues). LastPass has had a number of vulnerabilities exposed, and even had a successful hack attack on its own servers in 2016. But as a security conscious company should, LastPass offers bug bounties — which it honours — and is open about breaches with its users, while using best practice on its secure storage. So even the server breach in 2016 meant users' own passwords remained secure.

GABEN, SAVE US!

A question that security experts started to ask a while ago was: Is there anything better than passwords? You won't like the answer, but it's unlikely we'll ever be completely free from passwords, though two-factor authentication offers a respite. Called TFA for short, the premise is that people require two forms of identification, aka authentication; typically, the first is a strong password (something you know), and the second can be your fingerprint, your delightful face or a generated one-time-use passcode (something you have).

As you might have spotted, many phones are now using fingerprints and face scans to authenticate access. Financial institutes are even happy enough that NFC-equipped phones can authenticate credit card transactions. Some systems (LastPass, VeraCrypt) accept USB thumb drives and specialist USB keys (Yubikey, www.yubico.com)



as a second form of authentication. Steam is a good example of a service that was quick to provide two-factor authentication. You should be familiar with its email verification, which sends a code to your default email address, while more recently, Valve introduced the Steam Authenticator app, which is required if you're messing around with its trades. ■

Alternative managers

We're going to suggest three other commercial password managers — the ones that crop up most often, and generally offer similar features at similar costs.

So it's down to you which you feel works the best. The first is 1Password; prices start at US\$2.99 per month for a single user, and US\$4.99 for a family account for four people.

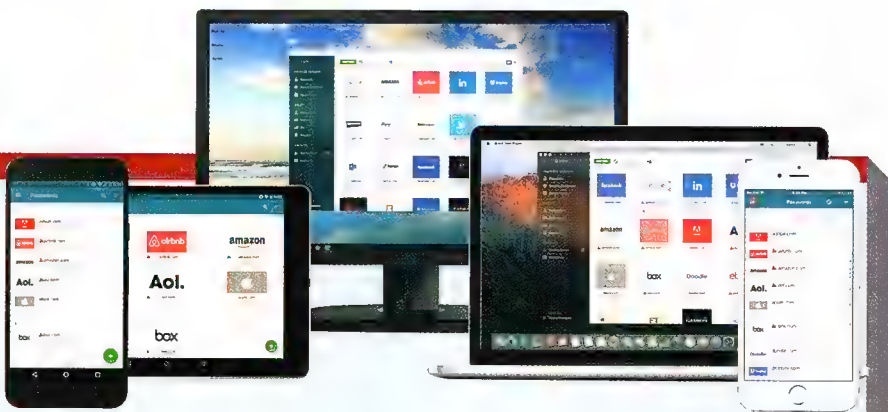
DashLane is a major player and offers a number of plans that will suit a wide range of consumer and business uses. The basic plan is free for all, but is limited to working on a single device. The paid home plan is US\$3.33 a month, and supports unlimited

devices, password sharing, and Yubikey TFA support. A business plan starts at US\$4 per user, and includes remote management, group sharing of passwords, and enhanced TFA options, among other things.

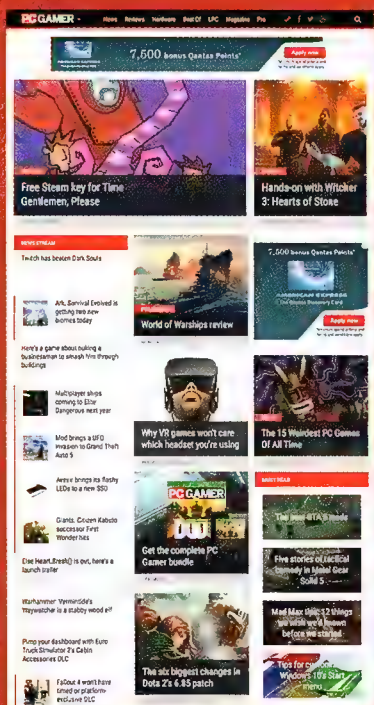
Our final option is Keeper Security. It has a similar structure to DashLane, but opts to have yearly subscription pricing. The basic single-user package is US\$29.99, effectively US\$2.50 per month, and offers unlimited devices

with sync, unlimited password storage, secure cloud backup, fingerprint access, and web access with support. A family option costs US\$59.99 for five users.

There are, of course, a host more password managers. You can find a vaguely independent list on Wikipedia at en.wikipedia.org/wiki/List_of_password_managers, or our sister website TechRadar maintains a list of free(ish) password managers at tinyurl.com/apc457-radar.



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Protect yourself from ransomware

Cat Ellis shows how to avoid ransomware, or rescue your PC if it's already infected.

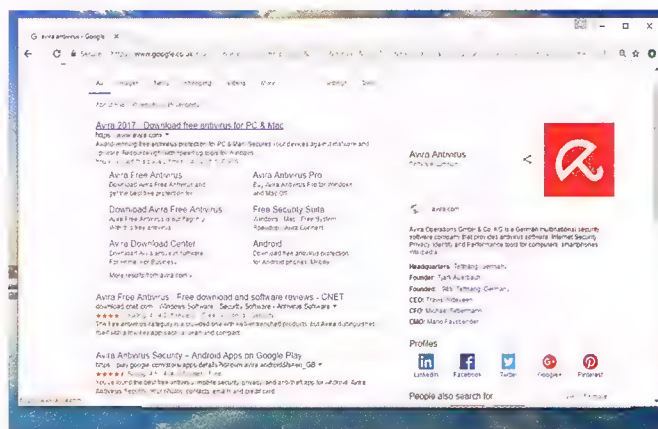
Ransomware is a particularly nasty type of malware (malicious software) that encrypts your valuable files and won't release them until you've paid a fee — usually several hundreds of dollars, if not thousands. Last year, computer systems in over 150 countries were affected by a virulent

strain of ransomware called WannaCry, with victims including universities and hospitals. It's a serious problem, but there are ways to avoid it, and to protect your files in case the worst happens.

If your PC is infected, you might be unable to access your documents, or you might not be able to log in at all.

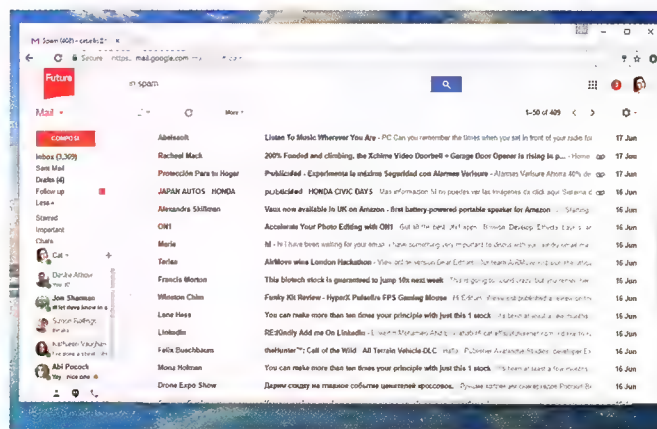
In either case, the most important thing is not to panic, and don't be tempted to pay the fee to unlock your files. There's no guarantee that they will be released, and even if they are, your money will be lining the pockets of criminals. Take a deep breath — it'll be fine.

Avoid or remove ransomware



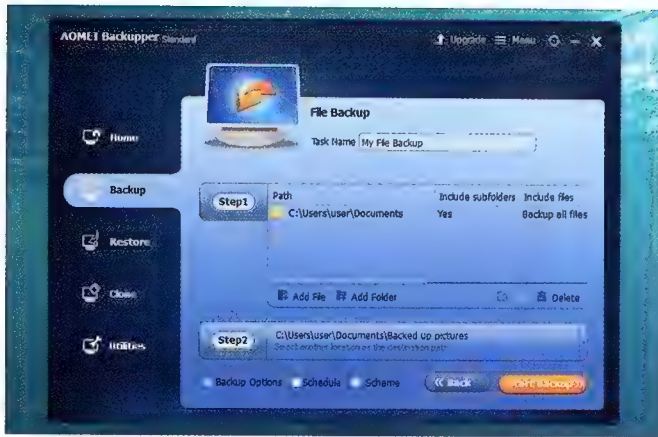
1 DOWNLOAD SAFELY

Malicious programs, such as ransomware, can be attached to files and programs downloaded online, so always be careful. When you're downloading a new app, make sure you get it from the developer's own site, not a third-party source, and make sure the URL begins 'https', indicating that it's certified secure. If you use torrent sites, only download from legal, legitimate sources.

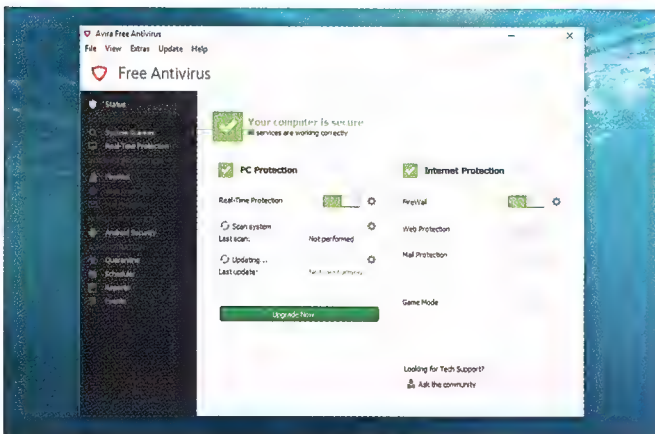


2 TAKE CARE WITH EMAILS

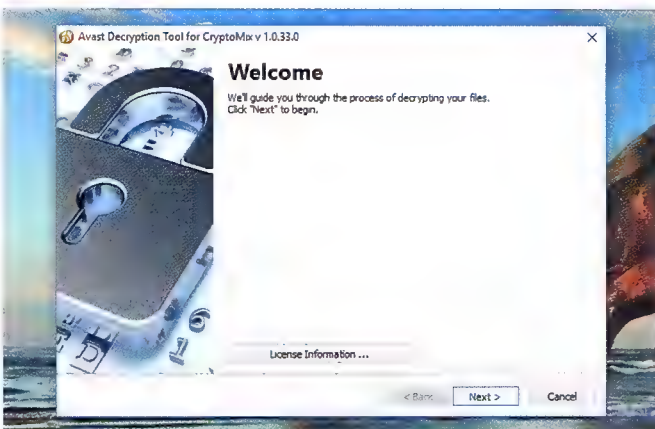
When you receive an email with an attachment — even if it's from someone you know — think carefully before opening it. Criminals often try to trick you by sending emails about parcels you aren't expecting or invoices that need paying, and sometimes your friends' email accounts can be hijacked to send messages. If you see an email that looks dodgy, delete it without opening it.



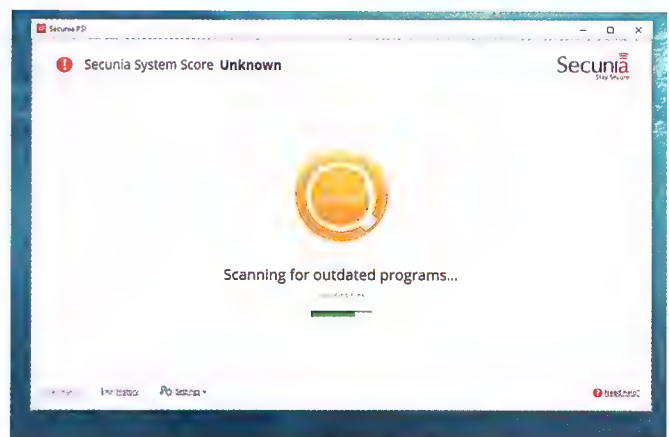
3 BACK UP YOUR FILES Prevention is better than cure. If you back up files regularly, you can simply restore them in the event of a ransomware attack — while also protecting them against physical damage or theft, if you keep the backup in a different physical location. Try AOMEI Backupper (bit.ly/2tbK5VO). It's a great free tool that makes backing up and restoring files as easy as can be.



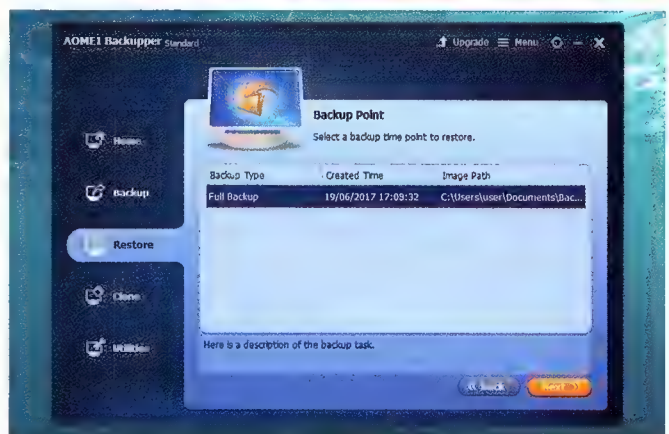
5 STRONG SECURITY SOFTWARE No PC should ever be without an antivirus program, but some cover a broader range of malware than others. Windows 10 comes with Windows Defender, but it doesn't have the best detection rates. If you're looking for an alternative, try Avira Free Security Suite (www.avira.com/en/get-antivirus). It's easy to use, and particularly good at detecting and blocking ransomware.



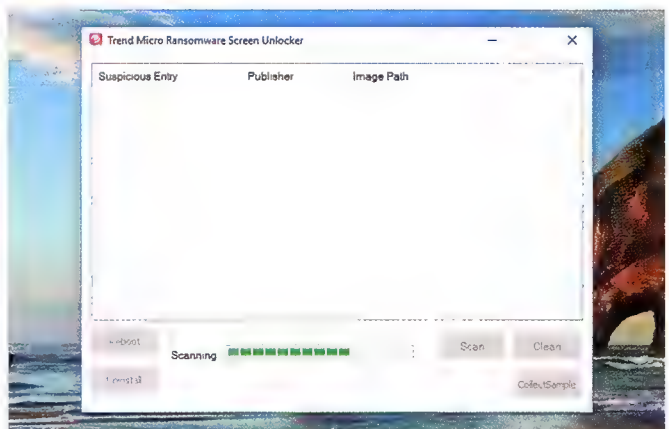
7 DECRYPT FILES FOR FREE If you don't have a backup, there are still ways to solve the problem without paying. Not all ransomware works the same way, so Avast has created a set of free decryption tools that you can use to unlock your files at bit.ly/2tbCiay. Clicking on the name of a program on the website will reveal the symptoms it causes, and download the tool you need to remove it.



4 UPDATE YOUR SOFTWARE Criminals often exploit security problems in Windows and other software. To avoid falling victim, make sure you install all Windows security updates when prompted. Many other programs update themselves automatically, but for those that don't, try the free Secunia Personal Software Inspector (bit.ly/2sKEQwD). It scans your PC for older software and downloads any updates.



6 RESTORE AND RECOVER All of these steps will help you avoid ransomware infection, but if something nasty slips through the net, don't panic. If you've backed up your system with AOMEI Backupper, you can restore it using the guide at bit.ly/2rSOLMA. Alternatively, insert your original Windows disc and select the option to repair or reinstall the OS. Microsoft has a guide at bit.ly/2nLIUdi.



8 UNLOCK YOUR SCREEN If your PC's screen has been locked, you need Trend Micro's Ransomware Screen Unlocker Tool (bit.ly/1qi5mSp). This comes in two versions: one for ransomware that still lets you start Windows in Safe mode (see the guide at bit.ly/299ejN1 to see if you can), and another if you can't. Either way, install the tool you need and the wizard will unlock your display in no time. ■

Security suites for Windows

Nathan Taylor reveals APC's current security suite picks for Windows.



Having a security suite installed is more important than ever. The protections built in to your operating system – be it Windows, Mac or Android – just aren't enough to comprehensively protect you and your family from the many and varied internet threats.

Although this might seem like a tax on owning a computer (and a hassle to boot), there is some good news. First, suites do more than they ever have before, and include conveniences like built-in password managers, parental controls, software version checkers, VPNs and backup systems – so their utility extends well beyond

protecting you from hackers and malware. Second, it's absolutely possible to get a free suite now, although, as you might expect, it won't be as good as a paid solution.

Below, we've looked at our favourite suites in three different categories: best overall, best for families and best free. The best overall is the suite that we think offers the best feature set, as well as provides excellent protection from malware. The best family suite is the one we think will work best for you if you have to manage the security of other people (especially kids and seniors), as well as your own. And the best free suite is what it says on the tin: the most value you can get without paying a cent.

WHAT TO LOOK FOR IN A SUITE

The modern suite has lots of features. Some of the things to check off your list should be:

- Good anti-malware
- Anti-spam
- Parental controls, including cloud management and parental advisory systems
- Backup, including online backup
- A secure browser for banking
- System cleanup tools
- Password manager
- Website filter
- Remote monitoring of multiple PCs
- Anti-ransomware
- A rescue disc

Finally, and perhaps most importantly, check the support terms. Being able to contact someone

AV-TEST CONSUMER SECURITY SOFTWARE TEST RESULTS

VENDOR	AHNLAB	AVAST	AVG	AVIRA	BITDEFENDER	BULLGUARD	COMODO	F-SECURE
TESTED PRODUCT NAME	V3 INTERNET SECURITY	FREE ANTIVIRUS	INTERNET SECURITY	ANTIVIRUS PRO	INTERNET SECURITY	INTERNET SECURITY	INTERNET SECURITY PREMIUM	SAFE
PROGRAM VERSION	9.0	18.2 & 18.3	18.2 & 18.3	15.0	22.0	18.0	10.2	17
PROTECTION								
PROTECTION AGAINST 0-DAY MALWARE ATTACKS	98.9%	98.9%	98.9%	100.0%	100.0%	100.0%	100.0%	100.0%
DETECTION OF WIDESPREAD AND PREVALENT MALWARE	100.0%	99.9%	99.9%	99.8%	100.0%	100.0%	99.8%	100.0%
PERFORMANCE								
PERFORMANCE IMPACT WHEN LAUNCHING POPULAR WEBSITES	7%	9%	13%	8%	24%	12%	6%	13%
PERFORMANCE IMPACT ON DOWNLOAD OF FREQUENTLY-USED APPLICATIONS	3%	0%	0%	2%	1%	0%	1%	1%
PERFORMANCE IMPACT ON LAUNCH OF STANDARD SOFTWARE APPLICATIONS	11%	16%	14%	8%	11%	13%	15%	4%
PERFORMANCE IMPACT ON INSTALLATION OF FREQUENTLY-USED APPLICATIONS	12%	35%	32%	23%	8%	30%	35%	59%
PERFORMANCE IMPACT ON COPYING OF FILES, LOCALLY AND IN A NETWORK	1%	1%	2%	2%	2%	24%	4%	10%
USABILITY								
FALSE WARNINGS OR BLOCKAGES WHEN VISITING WEBSITES	0	0	0	0	0	0	0	0
FALSE WARNINGS ON INSTALLING NEW SOFTWARE	1	0	0	1	6	8	1	12
FALSE BLOCKAGES OF CERTAIN ACTIONS CARRIED OUT WHILST INSTALLING AND USING LEGITIMATE SOFTWARE	0	0	0	0	0	0	0	0
FALSE BLOCKAGES OF CERTAIN ACTIONS CARRIED OUT WHILST INSTALLING AND USING LEGITIMATE SOFTWARE	0	0	0	0	1	0	0	4
PROTECTION SCORE	6.0	5.5	5.5	6.0	6.0	6.0	6.0	6.0
PERFORMANCE SCORE	6.0	5.5	5.5	6.0	6.0	5.0	5.5	5.0
USABILITY SCORE	6.0	6.0	6.0	6.0	5.0	5.0	6.0	3.5
TOTAL SCORE	18.0	17.0	17.0	18.0	17.0	16.0	16.0	14.5

TEST PERIOD: APRIL 2018. TEST PLATFORM: WINDOWS 10

24/7 when things go to hell is a big argument for owning a paid suite!

TEST RESULTS

Each of the suites reviewed here has been comprehensively tested by independent antiviral analysis company AV-Test (www.av-test.org). We've published here the latest results available at the time of writing, from April 2018. The results table covers all the products tested by AV-Test (not just the ones we reviewed).

Note that the results are not, in all cases, from the specific products we've reviewed. For example, we may have reviewed the full suite where AV-Test may have only tested the standalone antivirus application, or we may have a product that has been updated since the tests were performed in June. That doesn't change the validity of the results, since the same antivirus engine is in use.

Let's break down what the numbers mean, then:

- Protection against 0-day malware attacks is a measure of the suite's ability to detect new viruses based on their behaviour. It's perhaps the most important number here.

"Suites do more than they ever have before, and include conveniences like built in password managers, parental controls, software version checkers, VPNs and backup systems – so their utility extends well beyond protecting you from hackers and malware."

- Detection of widespread and prevalent malware shows the detection percentage of known viruses released in the four weeks before the test.
- The performance impact ratings give percentages by which the suite slows down a mid-range PC when performing common tasks.
- False warnings is the number of instances where the suite flagged legitimate software and websites as a threat and either blocked it or produced a warning popup.

For convenience, AV-Test also provides three overall scores, rating each suite's protection, performance impact and usability out of six, to give a total score out of 18. (Usability, in this instance, is not a reference to ease-of-use, but is based on the number of times the program produced false popups and blocked legitimate software). We should note that AV-Tests aggregate scores are based on combined Mar-Apr performance, while we've only printed April results for space reasons.

G DATA	K7 COMPUTING	KASPERSKY LAB	MCAFEE	MICROSOFT	MICROWORLD	PC PITSTOP	SYMANTEC	TREND MICRO	VIPRE SECURITY
INTERNET SECURITY	TOTALSECURITY	INTERNET SECURITY	INTERNET'S ECUITY	WINDOWS DEFENDER	ESCAN INTERNET SECURITY SUITE	PC MATIC	NORTON SECURITY	INTERNET SECURITY	VIPRE ADVANCED-SECURITY
25.4	15.1	18.0	20.8	4.12	14.0	3.0	22.12	12.0	10.1
98.9%	100.0%	100.0%	98.9%	100.0%	100.0%	96.8%	100.0%	100.0%	100.0%
100.0%	99.8%	100.0%	100.0%	99.9%	100.0%	99.8%	100.0%	100.0%	100.0%
35%	3%	20%	5%	4%	9%	10%	14%	17%	6%
1%	0%	0%	0%	0%	0%	0%	1%	0%	0%
14%	6%	11%	12%	12%	6%	8%	13%	19%	9%
46%	10%	26%	40%	49%	30%	9%	26%	25%	25%
8%	48%	2%	4%	4%	5%	1%	1%	2%	1%
0	0	0	0	0	0	0	0	0	0
8	2	0	0	4	8	43	3	0	8
0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
5.5	5.5	6.0	6.0	5.5	6.0	4.0	6.0	6.0	6.0
5.0	5.5	5.5	5.5	5.5	6.0	6.0	6.0	5.5	6.0
5.0	5.5	6.0	6.0	5.5	5.0	3.0	5.0	6.0	5.0
15.5	16.5	17.5	17.5	16.5	17.0	13.0	17.0	17.5	17.0

BEST OVERALL



\$70 FOR 5 DEVICES FOR 1 YEAR | WWW.BITDEFENDER.COM.AU

Bitdefender Total Security 2018

Still the overall best.

Although its overall rating took a modest hit in the most recent AV-Test benchmarks due to some overzealous filtering of new applications, Bitdefender Total Security remains our favourite suite overall, both for its extremely capable detection and removal system, as well as the sheer volume of features it supports.

The set of features available in Bitdefender is equalled by no other suite. Of course, it has your basics: firewall, anti-malware and anti-spam. But it protects against so much more. There's a secure browser for online shopping and banking, anti-theft tools for laptops and mobiles, a file shedder, a security auditor, system cleanup, version checking, webcam access monitoring, password manager, social network protection and much more.

We've been particularly impressed in this latest version with the file locker as well, which lets you lock down access to particular folders to block ransomware but make exceptions for specific apps. You could say, for example, that Word could access your docs folder, but other apps can't — which is much more convenient than other solutions that have you locking and unlocking your folders every time you want to do anything.

What's more, Bitdefender has continued to improve its parental controls, which is becoming a serious competitor to the likes of Norton Family and Qustodio. Comprehensive cloud-based controls, parental advisory systems and support for multiple platforms are all built in. What's more, the cloud management system, Bitdefender Central, extends beyond parental controls, allowing you to

monitor the security of your devices remotely, as well as trigger scans.

When it came to anti-malware performance, it achieved perfect scores in AV-Test's antivirus benchmarks, although it was a little overzealous when new software was installed. We've had excellent results with its removal engine, too — it does a good job of actually cleaning infections after detection, and includes a pre-boot mode for ripping problematic elements out. It also has one of the best recovery drive/disc creators going, with a good set of tools available for repairing a system that's so messed up you can't even boot into it.

Given the sheer volume of features built into BitDefender, you might expect it would be hard to use. It's not. Its autopilot mode gives you a 'set-and-forget' option that many users will find appealing.

RUNNER-UP

Kaspersky Total Security

No other suite has done as good a job at keeping up with Bitdefender as Kaspersky Total Security. Its feature set largely mirrors that of our winning suite, and for the most part, the various components are well designed and well integrated. All the tools you could really want are built into the suite — including backup, file encryption, webcam monitoring, cloud-based parental controls and a password manager. It even includes a volume-limited VPN for secure connections when you take your laptop onto public Wi-Fi hotspots.

It also managed perfect scores in the AV-Test benchmarks, and has only a modest impact on system performance. Overall, however, we don't think it has quite the elegance of design that Bitdefender has, and right now, it does have a slightly higher price — although at \$84 for three devices, it's still a good deal.

We've never had any real problems with autopilot, and it's smart enough to make firewall and cleanup decisions without your input. If you've more of a mind to manage the system yourself, you can: all the tools, options and reports are highly configurable. You can set multiple location profiles and adjust sensitivity sliders if you want to increase the aggressiveness of its scans.

The price listed is for the first year only, and Bitdefender may jack up the price for renewals, but given the quality of the suite, it's presently a real bargain.

Verdict

None better.



**BEST FOR FAMILIES
AND BEGINNERS**



RUNNER-UP

Trend Micro Maximum Security

If it weren't for Norton's parental controls and online backup, Trend Micro might have taken the prize as our pick for beginners. We've had excellent experiences with it when it comes to malware cleanup (we find that Norton too often gives a 'Get Help' response rather than cleaning the infection), and like Norton, it does a lot in the background without making a big deal about it. There's password management, link protection, cloud drive scanning, one-click system optimisation, folder locking, social media privacy checkups, a secure browser and a whole lot more.

It also covers up to six devices for your \$93, and that includes mobiles.



\$85 FOR 1 YEAR | AU.NORTON.COM

Norton Security Premium

Family-friendly and easy to set up.

Although we find ourselves a little unhappy at Symantec of late for the cancellation of the free version of Norton Family, the fact remains that, when it comes to family and beginner-friendly features, Norton is still on the top of the heap.

What puts Norton over the top is its elegant, simple interface, its rich feature set that includes online backup, and what is among the industry's best parental control solutions, easily rivalling and perhaps besting dedicated solutions like Qustodio and Net Nanny.

On that last point, the subscription for Security Premium includes a full sub to Norton Family Premier, a cloud-based parental control system with absolutely outstanding tools for managing and monitoring

kids' online activities. It generates reports, shows snippets of videos they're watching, lets you limit their access times or sites they can visit and much more. You don't have to go to their individual PCs and mobiles to set it up either: all the rules are managed through a portal site.

The online cloud backup tool is a really great one for beginners, as well. A lot of beginners don't do proper backups or subscribe to backup services, but this makes it easy to have automated backup to a secure cloud server, which is a key tool for mitigating ransomware attacks. Its biggest problem is that the 25GB limit is far too stingy – an awful lot of people are going to have photo collections way larger than that.

There are a lot of other things going on in the

background of Norton. It managed a perfect score in AV-Test's benchmarks and had only modest impact on performance. There's a ton of hidden features, too, such as banking protection, website filtering, identity protection, password management, system tuning and cleaning and more. It does all these things automatically, without making any kind of fuss about them (especially when running in silent mode), which is what makes this so great for beginners.

Like many suites now, the Norton Security licence also applies to mobile devices and Macs. Norton is actually one of the few suites with a really great mobile app. Its mobile parental controls are particularly good on Android, where all the rules that you configure can still be

applied – access times, site filtering, reporting and so on. Passwords stored on desktops will be taken to your mobile as well.

We love the elegance of the solution overall. It does an awful lot without trumpeting any of it. Setting it up requires very little expenditure of effort, and even the online backup system intelligently figures out what to backup for you and requires virtually no setup.

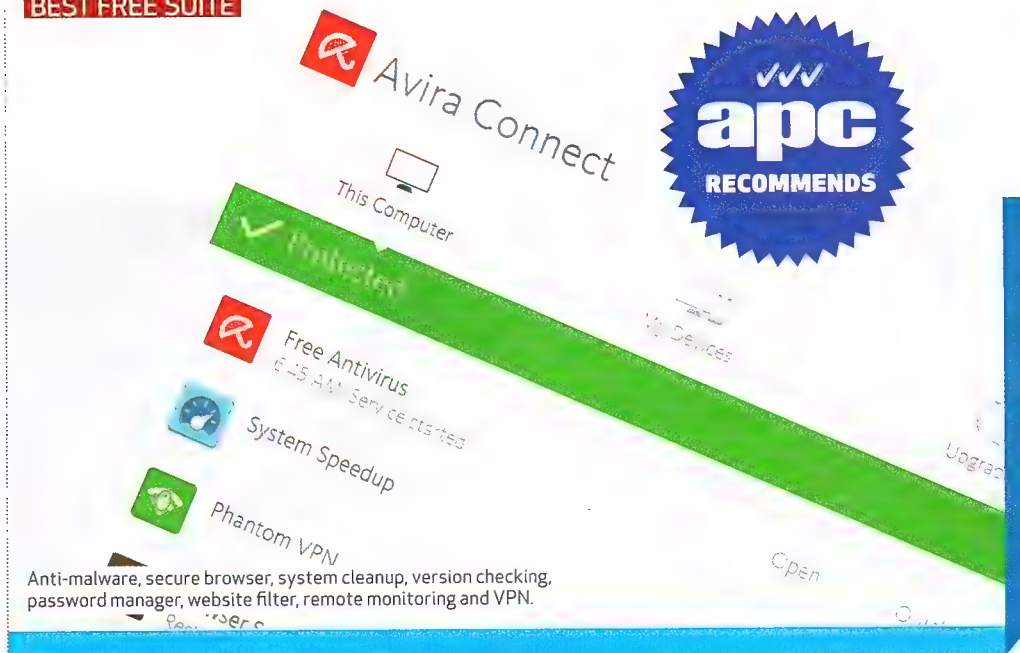
The perfect solution for people who just want to install and forget.

Verdict

Automated cloud backup and outstanding parental controls make Norton a great solution for families.



BEST FREE SUITE



FREE | WWW.AVIRA.COM

Avira Free Security Suite

If you're looking for something for nothing, look no further.

Once upon a time, if you wanted a free security solution, you had to cobble it together from various free apps. You don't need to do that anymore. Avira, Qihoo, Comodo, Outpost and Panda among other offers full suites – completely free. Of course, you can still roll your own if you really want to, but why would you when a single solution is so much easier?

When it comes to free suites, none offers more than Avira. It provides anti-malware, system tune-up, a cloud-based password manager, secure browser, a volume-limited VPN (with 1GB/month), a web and search filter, and a software update checker. You can manage multiple devices from a single desktop, as well. It's a pretty comprehensive package for something

that costs nothing. It will not, however, completely rival a commercial suite. It's good, but it's not up to par with the likes of Symantec, Bitdefender and Kaspersky.

It has no firewall, for instance – it uses Windows firewall – and a number of the deeper features you might find in those suites are missing. There's no ransomware locker and no webcam monitor or application sandbox. The tune-up tools are restricted in the free version, and there are no backup tools or parental controls.

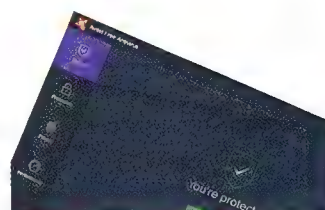
On the other hand, what is there is pretty good. Avira's anti-malware engine received a perfect score of 18 out of 18 in AV-Test's benchmarks, being both effective and light on system resources. It cleans a system well, and the extra tools are useful across the board.

The VPN is particularly convenient, and the Scout secure browser is excellent for both banking and general usage.

As you might expect, there is some upsell built in to the app. For instance, you're reminded that the VPN is limited to only 1GB per month, while the paid version offers unlimited access. The software update checker and system optimisation tools are likewise a little crippled, with the full set of features only available in the paid version of the suite.

The suite isn't difficult to use, though it is a little scattershot and not terribly well integrated. It's chattier than something like Symantec, but for the most part, it's straightforward and comprehensible for both beginners and advanced users.

Avira Connect is a particular high point.



RUNNER-UP

Avast Free Antivirus

Although it's not marketed as a 'suite', Avast Free Antivirus is more than just an anti-malware application. It also includes a (pretty good!) password manager, secure browser and a modest set of utilities for monitoring Wi-Fi security and identity theft. It's very easy to use, and has excellent antivirus detection rates.

It's not anywhere near the kind of full suite that you'll get in a commercial product, but for an advanced user who is careful and doesn't need a lot of the hand-holding that a full suite provides, it can be more than enough.

Avira Connect lets you manage multiple devices from a single PC. It's more than just monitoring alerts: you can see the status of components as well as trigger remote scans.

Nobody should install Avira Free Security Suite thinking that it's going to be just as good as a \$100-per-year commercial suite. It's most definitely not. But for the price of \$0, it offers an awful lot, even including some things that commercial suites don't, like VPN support. If you're not going to pay for a suite, this is definitely the next best thing. ■

Verdict

Although it doesn't rival a paid suite, you still get good protection for the total price of zip.



THE
MOST FUN
YOU CAN
HAVE WITH
YOUR HANDS
WITHOUT
GOING

games
radar

MORE KICKS PER CLICK

Protect your Android

Lindsay Handmer reveals everything you need to know about defending your Android phone or tablet.

Increasingly, we are storing and accessing our entire digital lives through a smartphone, and security is a growing issue. It's not just personal information, but breaches can leave your bank accounts, credit card or services open to attack. Fortunately, security on Android is generally excellent, and there are plenty of third-party options available for extra peace of mind.

SECURITY UPDATES

Devices in active use, yet which are not kept updated, are one of the biggest Android security problems. In 2017, half the Android devices in use didn't receive regular updates, leaving them exposed to new vulnerabilities. It's not just users falling behind on updates — many manufacturers don't support older models for very long. Keep your Android device updated, or if updates are not available, consider upgrading to a newer model.

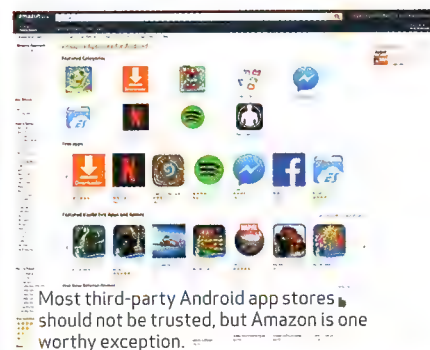
MALICIOUS APPS

The second largest threat to Android security are malicious apps, which can do anything from harvest personal information, to pop up annoying ads. The vast majority of problem apps

come from sources outside of the Google Play Store. In 2017, only 0.02% of Google Play Store apps were compromised, so the vast majority of issues come from using third-party app stores. App stores such as Amazon are generally safe, but the numerous third-party stores (even the largest, such as getjar.com) are best avoided outright.

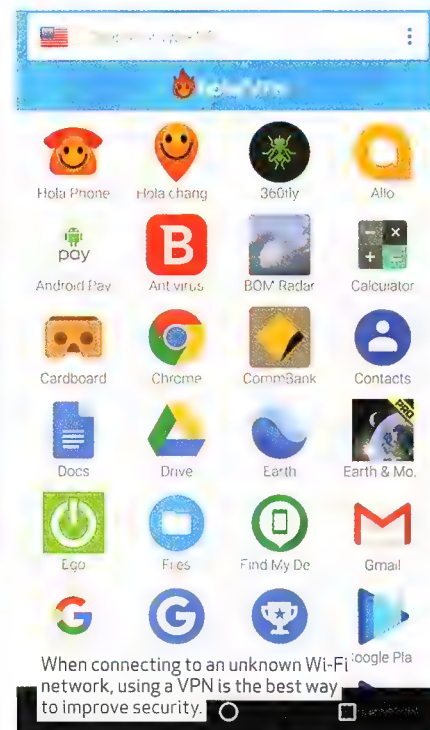
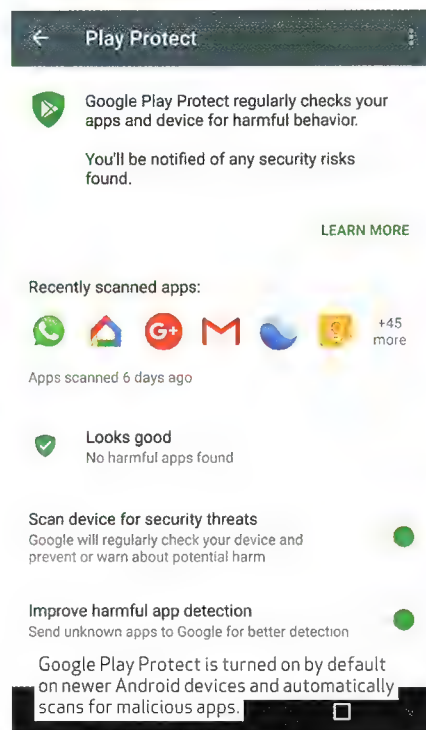
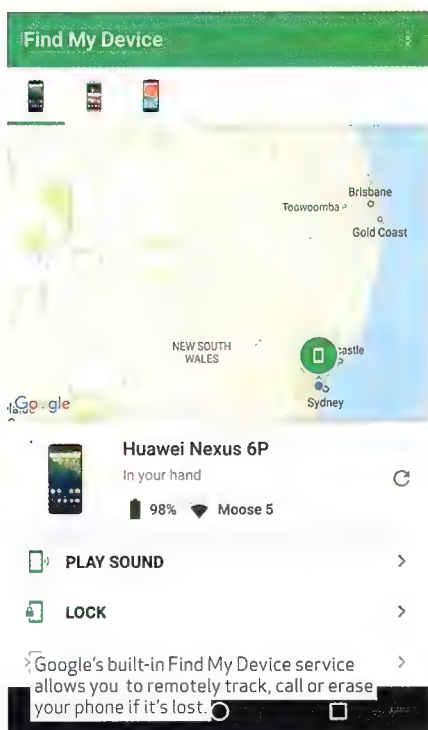
PHISHING ATTEMPTS

Links in SMS, email, apps or websites can be used to trick users into visiting a malicious page, or downloading a infected app or file. If someone else's device is already infected, the messages can look like they are coming from a legitimate source. Getting infected yourself can result in anything from secret premium calls or text to rack up bills, to stealing personal information, or just popping up ads. The best way to avoid infection is to not visit any links that you don't trust, especially from unknown sources, such as via SMS. Google does have inbuilt safe browsing in apps such as Chrome and Gmail, which can help provide protection, but are not foolproof.



How we tested

Despite stiff competition, our winners have a strong track record and have dominated our testing for another year running. No matter if you are continuing your Android protection or just getting started, these apps are a great choice. Our recommendations are based on installing the top security apps, and evaluating for usability, features and battery life impact. We use the comprehensive malware detection comparisons from www.av-test.org to gauge security effectiveness.



WI-FI WOES

Accessing an unsecured Wi-Fi network is an easy way to have your data snooped on or harvested. Even supposedly safe, secure Wi-Fi networks can be compromised or fake. The best bet is to avoid Wi-Fi unless you know the source is safe (such as at home or a friend's house), or use a VPN. For Android, TunnelBear VPN (www.tunnelbear.com) includes 500MB of monthly data for free and is ideal for occasional use. Otherwise NordVPN (nordvpn.com) costs ~\$3.50 per month, but can be used on multiple devices (including PCs and Macs) with no bandwidth restrictions.

ACCOUNT AND PHYSICAL SECURITY

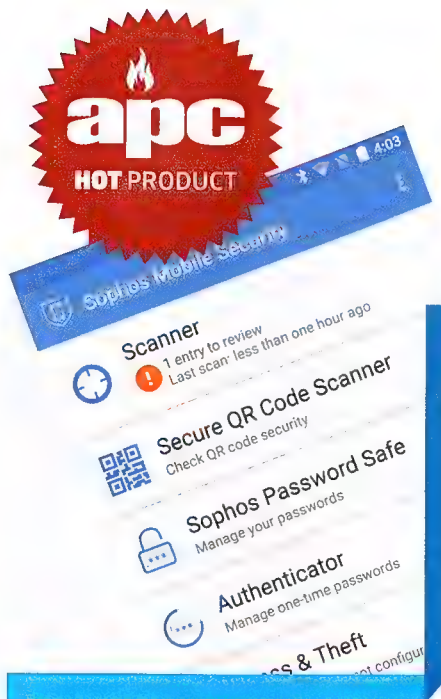
While malware is a big concern, the security of your Android device also depends on restricting outside access. Your smartphone should use a PIN or fingerprint security, and make sure notifications are not set to show up on your lock screen. Make sure any passwords (or PIN) used is not easy to guess, or reused across multiple accounts. Turn on two-factor authentication for your Google account, as well as for services such as internet banking. It's possible to see if a password has been compromised through a third-party hack on haveibeenpwned.com — change the password immediately and discontinue its use if so.

BUILT IN ANDROID SECURITY

Fresh out of the box, your device is already pretty secure. Google Play Protect is enabled on Android phones with the latest version of the Google Play Store app, and the service checks 2 billion devices and 50 billion apps every day, and removes anything malicious. Apps are sandboxed, devices are encrypted, and you can locate, lock, wipe or call your phone by typing "find my phone" into Google when signed into your account. Older devices are also kept somewhat protected by Play Store scanning.

SECURITY APPS

For those who want extra protection, there are loads of free and paid security apps. We have included a review of two of our favourite here, but there are plenty of other options with features that suit different users. A great way to compare how effective they are is with AV-Test's Android security testing (www.av-test.org), which compares features and rates each app.



FREE | WWW.SOPHOS.COM

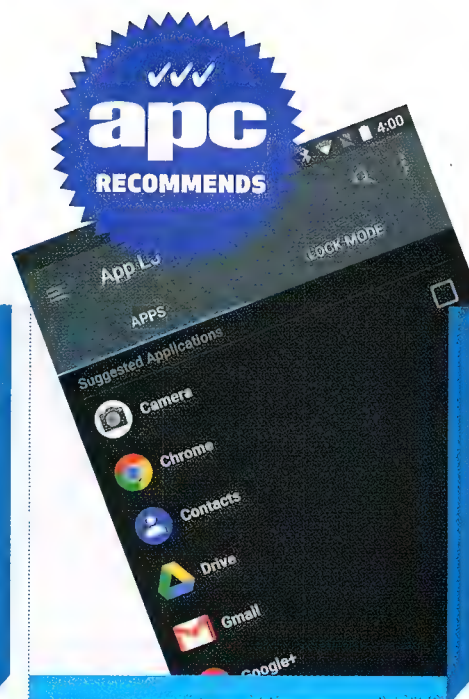
Sophos Mobile Security

Best free Android security suite.

By far our favourite option, Sophos Mobile Security is 100% free for personal use, with no ads or reduced functionality. Even better, in the 14 tests since 2014, Sophos has picked up 100% of malware in the AV-Test security app comparisons. Sophos Mobile Security scans apps on install for any malicious content, and can perform on demand or scheduled scans of a device's contents. It also has a comprehensive theft protection system, which includes remote locks, wipes, location tracking and sim change detection. The app also protects from other threats and annoyance, including web filtering and URL checks, spam call and SMS blocking and insecure Wi-Fi monitoring. It includes a built-in Authenticator service and password manager, can protect apps with a password, pin or fingerprint, and lists apps that could access personal data. Despite all the features, it's easy to get up and running, but offers loads of advanced options. Effect on battery life and performance is minimal.

Verdict

Feature-rich and quite easy to set up for beginners, Sophos Mobile Security is by far the best free option around.



\$19.99 A YEAR | WWW.BITDEFENDER.COM.AU

Bitdefender Mobile Security & Antivirus

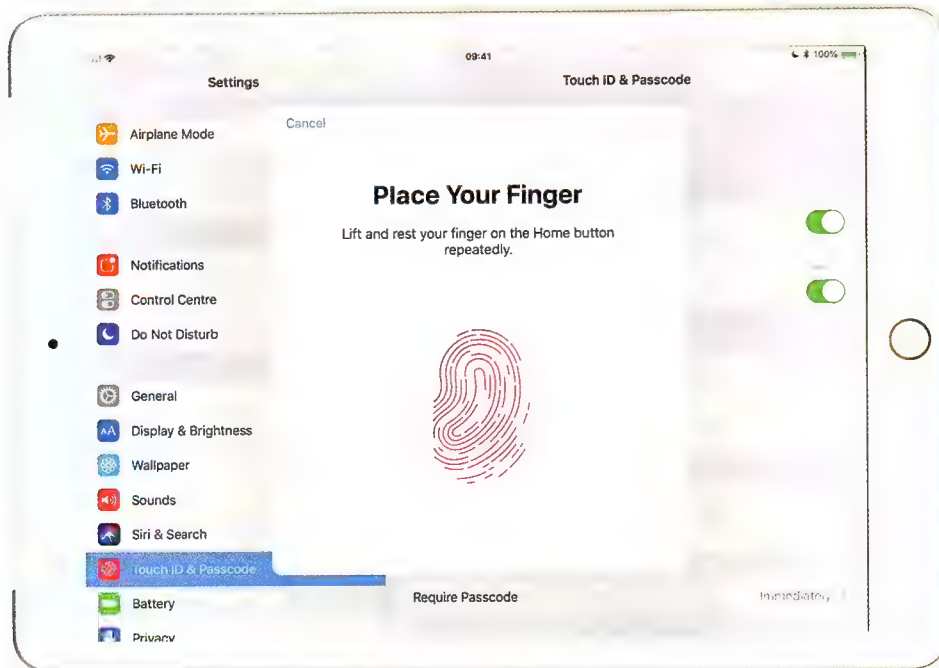
Best paid pro Android security suite.

Try before you buy with a 14-day free trial. The app stands out thanks to key features not found on most free competitors, including checking your email for account breaches. It also extends security to a smartwatch, and can be used to sound an alarm if you're separated from your phone. The web security is a cut above most, especially with Chrome, and includes an app locker (with fingerprint support and smart unlock) and privacy advisor. The anti-theft is also above average, with premium features such as mugshots pics, and the ability to listen in on the phone, as well as the usual tracking and wiping options. Bitdefender also picked up 100% of malware in AV-Test's latest comparison. The Bitdefender Mobile Security & Antivirus app is intuitive to use, and doesn't have a noticeable impact on battery life, or phone performance. While the competition from free alternatives is stiff, Bitdefender is a great paid option, especially for those with Android wearables. ■

Verdict

Boasting extra features not found on free options, including wearables functionality, it's definitely one worth checking out.





Touch ID combines security and convenience: a short press of your fingertip and access is granted.

Secure your Apple devices

Alex Blake reveals how to protect your Mac, iPhone or iPad.

Apple is known for the security of its devices, but as the proliferation of digital technology has accelerated, Apple devices have become more appetising targets for the ne'er-do-wells of the world. That means it's more important than ever to understand how to make your devices as secure as they can possibly be.

Despite its reputation for watertight security, Apple has suffered embarrassing security slips in the recent past – from text messages crashing iPhones because of dodgy glyphs, to the discovery that the all-powerful root user on the Mac could be accessed without a password. And then there's Meltdown and

Spectre – vulnerabilities which affect a huge range of modern processors, including those found on the Mac, iPhone and iPad.

These stories illustrate the need to keep your Apple devices up to date, and ensure you don't miss out on essential patches, but installing updates isn't the only way you can keep your devices safe.

Apple has been careful to stop threats in their tracks, with features like Gatekeeper, FileVault and the Secure Enclave (see below). The recent scares were exceptions that proved the rule. As an Apple user, you are more resistant to hacks, exploits and other nasties than if you used Android or Windows.

SANDBOX SAFETY

One reason for that security is the way Macs handle and install apps. Each app is 'sandboxed', meaning its privileges are limited, making it harder for malicious code to put your computer at risk. It's also very easy to see what apps are able to access on your computer. For example, go to 'System Preferences > Security & Privacy > Location Services' to see which apps can find out about your location. On your iPhone, you can get the same information in 'Settings > Privacy > Location Services'.

Still, there are plenty of things you can do to strengthen the security of your devices – and we're going to show you how over the next few pages.

Apple's hardware protections

Although they're both intended as convenience features, rather than security features, Face ID and Touch ID on iPhone and iPad are still very secure.

That is due to their built-in Secure Enclave, an isolated hardware mechanism used to protect your fingerprint and facial data. It doesn't store that data as an image, but as 'a mathematical representation', which can't be reverse engineered. That data is encrypted and is not sent to Apple, and it's protected with a key that's only available to the Secure Enclave itself.

That's not the only method Apple uses to protect your data. The latest MacBook Pro, for example, comes with a Touch ID sensor embedded in its Touch Bar. This is powered by a dedicated T1 chip, which houses the Secure Enclave to process your data.

The iMac Pro has the T2 chip, the second generation of Apple's secure processor. It enables new encrypted storage and secure boot capabilities in the iMac Pro, while also handling things such as the FaceTime HD camera's image signal processor, used for exposure control, among other tasks.

It's best to stick to apps from the Mac App Store, or at least those from 'known' developers.

Protect your Mac

A few simple settings to keep your Mac safe.

One of the advantages of macOS is the system's built-in security features. Ideally, you should get Mac apps from the Mac App Store. However, sometimes you may want an app from a third-party. Apple can give developers a unique ID for their apps — Gatekeeper uses this to recognise legitimate apps, and can block those that don't have a valid ID.

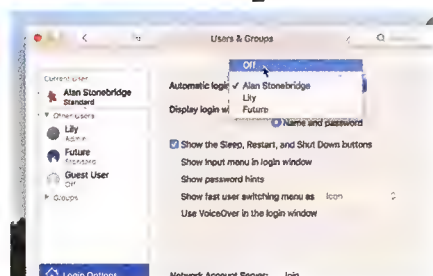
Another useful feature is FileVault. This lets macOS encrypt your Mac's startup disk, preventing unauthorised access to key areas of your computer.

You should always protect your Mac with a strong password, too. Use the password generator in Keychain Access, in 'File > New Password Item' and click the button that shows a key.

Finally, create two user accounts. Make a standard account for everyday use, and a more powerful admin account for app installs and security purposes.

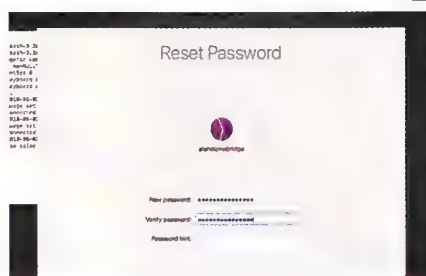


Secure your Mac in six simple steps



1 MANAGE LOGINS

In System Prefs, click 'Users & Groups'; under your username, you can add a password or change an existing one. In Login Options, make sure you turn off Automatic login, too.



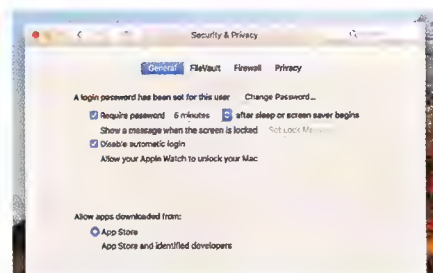
2 RESET USER PASSWORDS

To reset an account password, hold 'Cmd-R' at startup. When the macOS Utilities window appears, go to 'Utilities > Terminal', type 'resetpassword', then follow the on-screen instructions.



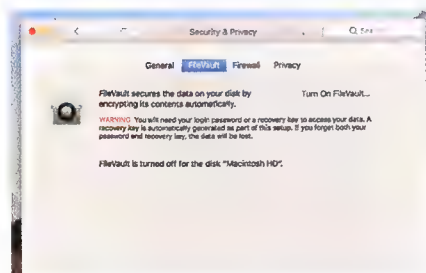
3 FIRMWARE PASSWORD

If you're worried about passwords being reset from Terminal, set a firmware password. Hold 'Cmd-R' at startup, go to 'Utilities > Startup Security Utility', then click 'Turn On Firmware Password'.



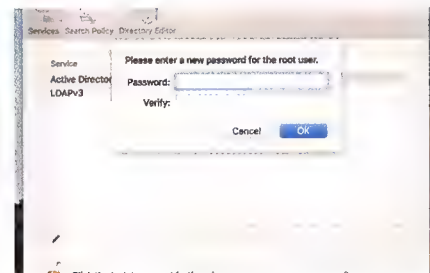
4 GATEKEEPER

To change your Gatekeeper settings, go to 'System Preferences > Security & Privacy > General'. Here you can choose whether to allow apps from outside the App Store to be installed.



5 FILEVAULT

In 'System Preferences > Security & Privacy', click the FileVault tab, then the padlock icon. Type an admin name and password, then click 'Turn On FileVault'. The Mac then silently encrypts its drive.



6 ROOT USER

This has total access to your Mac's files, so don't enable it without a very good reason, and be sure to disable it afterwards. See bit.ly/mfru for help — and give it your own strong password!

Quick tips

APP DOWNLOADS

Only get apps from the App Store or directly from developers approved by Apple. Never tell your Mac to run other apps, unless you're 100% confident in the source.

PASSCODE LENGTH

Don't use a short four-digit passcode on iOS. Instead, consider increasing it to eight characters or more and including numbers, symbols and mixed-case letters.

PASSWORD MANAGERS

Use Safari's password suggestions or a password manager like LastPass. Make sure it's not a word that can be easily associated with you or someone you know.

ADMIN ACCOUNT

Don't use the main (admin) account on your Mac day to day — create a new standard account instead. Also, add a firmware password to prevent any account's password being reset without your permission.

AUTHENTICATION

Enable two-factor authentication on websites and your Apple ID in order to add another layer of security.

SYSTEM UPDATES

Download the latest macOS and iOS updates to get fixes from Apple to plug potential security holes.

TRAFFICLIGHT

There are browser extensions that can alert you to suspicious websites. If you're using Safari, try TrafficLight at: (bitdefender.com).

DON'T GET COMPLACENT!

Using a Mac or iPhone won't make you invulnerable. Always take precautions and secure your Apple devices against threats — getting complacent can put you at risk.

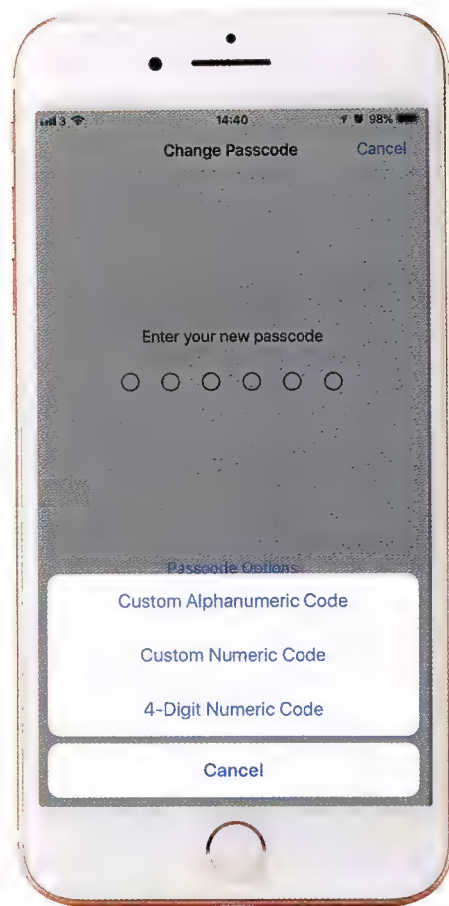
iOS security

What are the steps you can take to make your iPhone and iPad more secure?

In March 2018, news emerged of a mysterious box called GrayKey, which allowed anyone to gain access to an iOS device's contents, locked or otherwise.

While the device is intended for law enforcement use, it highlights an issue that's relevant to us all: weak device passwords can be a real security issue. That's because GrayKey reportedly uses a 'brute force' attack to repeatedly guess the target device's password until it gets it right and gains access.

Matthew Green, a security researcher at Johns Hopkins Information Security Institute, suggests increasing the length of your password (as well as mixing in alphanumeric characters).



According to his calculations, a 10-digit password would take GrayKey (or other brute-force attackers) around 12 years to crack. A four-digit one, on the other hand, would take 6.5 minutes.

RESTRICTED MODE

To help combat brute force attacks from devices such as GrayKey, Apple is adding a new feature to iOS called USB Restricted Mode. Already present in iOS 12 and iOS 11.4.1 betas, this blocks communication attempts through the Lightning port on an iOS device if it hasn't been unlocked for over an hour — this should prevent attackers from installing brute-force software.

Passcode options

1

You can change your passcode in 'Settings > Touch ID/Face ID & Passcode'. When doing so, tap 'Passcode Options' for a few more choices.

2

Tap 'Custom Alphanumeric Code' to enter a passcode comprised of letters, numbers and symbols. It's a good idea to mix in upper- and lower-case letters.

3

If you'd rather stick to numbers, you can choose a Custom Numeric Code. This can be as long as you like, so it can be more secure than a six-digit code.

4

The final option is to switch to a four-digit passcode. We don't recommend this as it's trivial for a system like GrayKey to crack, or a nearby person to observe.

Two-factor authentication sends a verification code to a trusted device (your iPhone, iPad or Mac, say) to further ensure security.



Two-Factor Authentication



A message with a verification code has been sent to your devices. Please enter the code to continue.

[Did not get a verification code?](#)



Spectre & Meltdown

You've probably heard of Spectre and Meltdown — they were hard to miss in the news in January. Both are serious vulnerabilities affecting huge numbers of processors, including those in all modern Macs, iPhones and iPads (Watch is unaffected).

Meltdown targets the way your operating system and apps are isolated from each other, while Spectre breaks the separation between two apps. Both can be patched, but Spectre is harder to mitigate (although it's also harder to exploit).

In order to remove the exploits in the future, processors will need to be designed differently. Luckily, Intel, AMD and ARM have pledged to do just that.

Apple was quick to patch the vulnerabilities, issuing updates in macOS 10.13.2, iOS 11.2 and tvOS 11.2. Make sure you have them all.

Apple ID and iCloud

Sync your data in safety.

Given that it houses your notes, photos, reminders and much more, iCloud is unsurprisingly pretty secure. Between your Apple ID, iCloud Keychain and Apple's encryption methods, your files are kept safe and sound in the cloud.

One simple way to keep your iCloud account extra secure is to set up two-factor authentication (2FA). This adds an extra layer of security to ensure that someone can't gain access to your account if they have your password — they also need a code sent to your trusted devices.

Bear in mind that you should set up 2FA for every Apple ID you have. If you signed in to iTunes on an old Windows PC years ago, then bought a Mac and set up a new Apple ID at a

later date, you'll probably now have two Apple IDs, and so should set up 2FA for both of them.

Limiting access by using 2FA is not the only way your iCloud data is kept safe from threats. There's also iCloud Keychain, Apple's built-in password manager for your Safari usernames and passwords, credit card and Wi-Fi network info. It can also sync your account information for a range of Apple services like Mail and Messages, plus third-party websites, to all your Apple devices.

All that data is encrypted by Apple, both on your devices and in transit, to ensure it cannot be read by unscrupulous actors. Because these features are integrated into Apple's systems, they're free and easy to use.

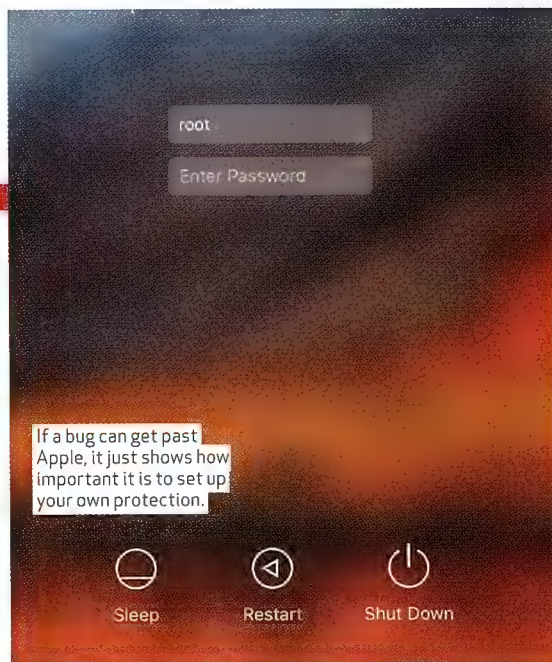
Apple's security scandals

Apple's reputation for super-tight security has taken a hit over the last year or two. Of serious concern was a bug involving the root user account in macOS. It was found that this powerful account could be accessed by anyone, simply by typing the username 'root' followed by a blank password on a Mac's login window, then repeatedly hitting the Return key.

In 2015 and 2016, Apple was at the centre of a row with the FBI when it refused to unlock an iPhone possessed by one of the perpetrators of the San Bernardino shooting. Apple argued that doing so

would weaken the security of all iPhones and create a backdoor, but Apple's critics stated that it was hindering the investigation of a terrorist incident.

The App Store has also come in for criticism over the ability of bogus and exploitative apps to gain prominence in App Store search results. Apps that masquerade as legitimate services but charge users inordinate amounts in monthly payments have often been spotted at the top of iOS search results, as reported by the press. ■



Securely delete data with Eraser

Worried about your old data? Nate Drake offers a permanent solution.

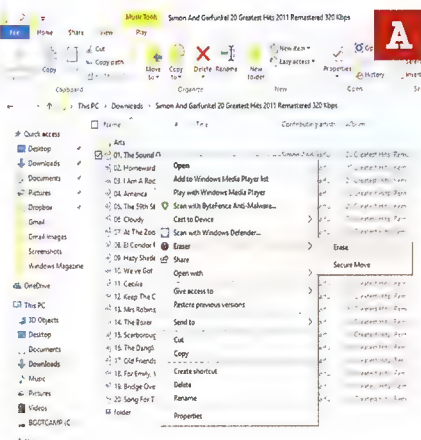
The revelations by Edward Snowden about NSA spying activities and the recent introduction of stringent data protection laws in the EU have left everyone, from privacy-minded individuals to big businesses, worried about data security. As any power user knows, any files that are nominally 'deleted' by Windows usually remain on your hard drive. The OS simply changes a few bits in the file header to tell the system the data is no longer required. As useful as this is for legitimate users who may have deleted data by accident, bad actors, such as hackers, can use freely downloadable digital forensic tools to recover your files in seconds.

Eraser, which comes to us courtesy of Heidi Computers in Wicklow, Ireland, seeks to restore the balance. This free utility works by repeatedly overwriting every bit of data in files or folders you select to delete it securely. Eraser is highly customisable: You can choose your own erasure method, such as seven passes of pseudo-random data, and can even automate tasks, such as overwriting free space on your hard drive. While Eraser isn't completely effective when it comes to flash memory (see opposite) and more advanced forensic techniques, you can gain some peace of mind knowing you're using the very best erasure methods available.

1 SET UP ERASER

Open your web browser of choice and navigate to eraser.heidi.ie/download. Click the Download tab and then choose the most recent stable version of Eraser, which is at the top of the list. Your browser is now redirected to Source Forge, which hosts the installation files. Windows 10 displays a security alert at this stage. Click Yes to begin installation. The setup wizard first tries to install the .NET Framework 4 on your machine. If this is already installed on your version of Windows, you may see a system prompt. Click Close to proceed. Select Next on the welcome screen, and check 'I accept the terms in the license agreement'.

■ The wizard now asks you to choose an installation type. A Typical install



incorporates all of Eraser's main features. Choose a Complete installation if you want to include additional functions, such as shell extensions. Click the Install button once you've chosen the type of installation you want, then click Finish to close the setup wizard.

2 ERASE DATA

If you chose to install shell extensions, you can access Eraser with just a few clicks of your mouse. Open the File Explorer, and navigate to the file or folder you wish to securely delete. Right-click to open the context

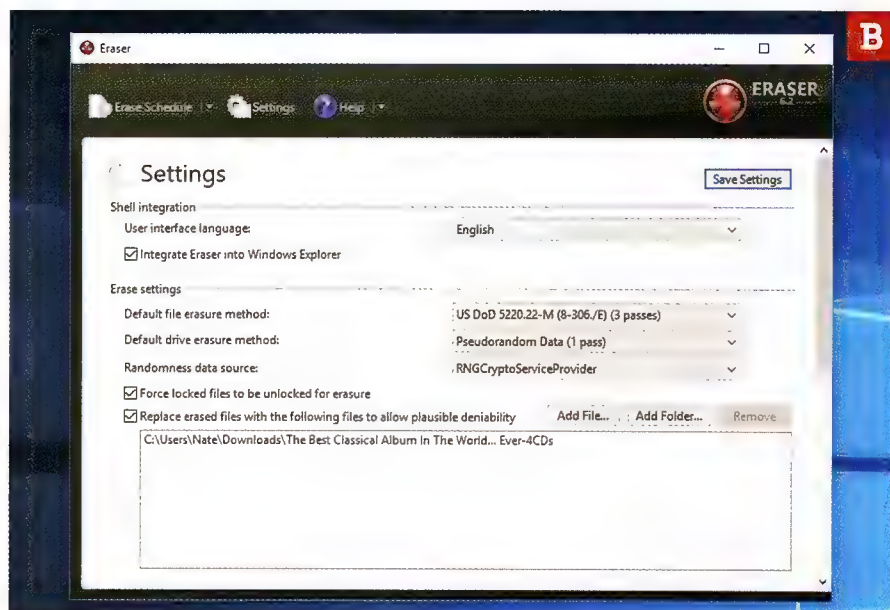
menu, and move your mouse to 'Eraser', then choose Erase [Image A]. The first time you do this in Windows 10, you'll need to click Yes to grant Eraser permission to make changes.

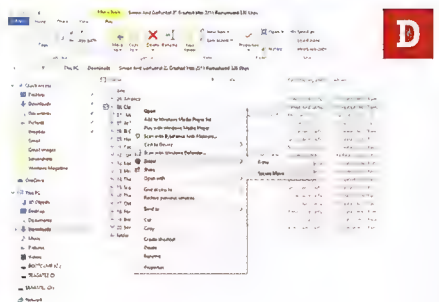
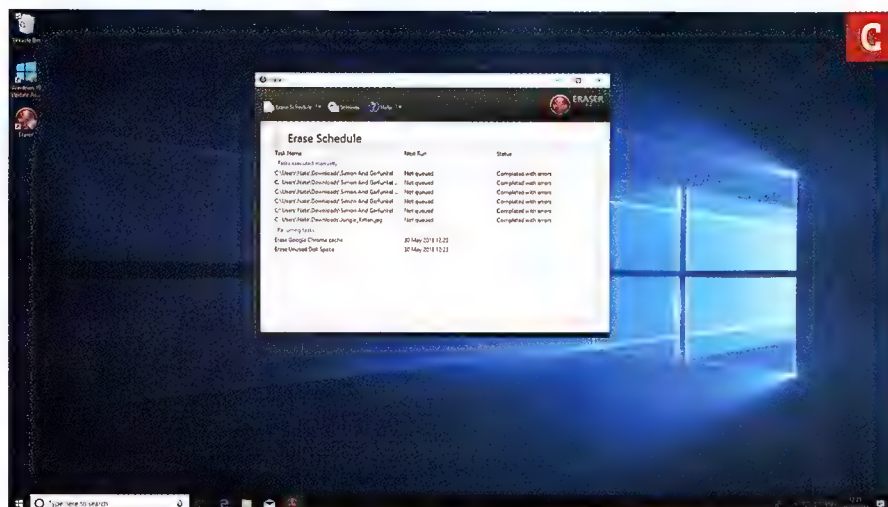
■ Eraser asks you to confirm before proceeding. Remember that any data removed will not be stored in the Recycle Bin prior to deletion, so carefully check you have the right information before clicking Yes. Eraser displays a notification reading 'Task Completed' once your data has been securely erased. This may take some time, depending on Eraser's configuration.

3 CONFIGURE ERASER SETTINGS

By default, Eraser uses the Guttmann method to delete files, which involves overwriting data 35 times. While this is ultra-secure, it's usually overkill for most users, and can take hours or days to complete for larger files. Fortunately, Eraser supports a number of different methods to remove data.

■ Launch Eraser and click Settings. Find the 'Erase Settings' section, and select the drop-down menu marked 'Default file erasure method'. The US Department of Defense standards for erasing data involve either three or seven passes, depending on the sensitivity of the





information. While theoretically not as secure as the Gutmann method, they are much more efficient. Click 'Save Settings' at the top-right to confirm changes.

4 PLAUSIBLE DENIABILITY

While deleting files with Eraser makes them very difficult to recover, anyone with access to your hard drive can potentially view the clusters of pseudo-random data on your drive, and realise that you have something to hide. Mercifully, Eraser supports 'plausible deniability'. This works by placing a harmless-looking file, such as an MP3, over erased data, making it much more difficult to tell where sensitive files were located previously. To do this, first choose a folder to use for decoy files, such as a music album. Open Eraser's settings, and check 'Replace erased files with the following files to allow plausible deniability'. Next, click 'Add folder' and select your chosen files [Image B]. Click 'Save Settings' once you are done.

■ Note that with the advent of file journaling and SSDs, plausible deniability has become difficult to achieve in practice. We strongly recommend using full-disk encryption (see opposite).

5 SCHEDULING TASKS

Eraser supports automated deletion of data [Image C]. This is useful for removing files in obscure locations, such as your web browser's cache.

■ Click 'Erase Schedule', then select 'New Task'. Under 'Task Properties', first enter a meaningful name in the name field, such as 'Erase Google Chrome cache'. Choose 'Recurring' under 'Task Type', then click 'Add Data'. In the new window, select 'Target type' — for example, 'files in a folder' — and choose an erasure method, such as Gutmann. Use Browse to enter the file or folder path, then click OK to confirm. Finally, click the Schedule tab to determine the time and frequency of your new task, such as at 1.30pm daily. Click OK to set your new scheduled task.

■ You can also use this feature to regularly erase free space on your hard drive. Simply choose 'Unused disk space' in the 'Add Data' section. You can also manually overwrite free space on any drive by right-clicking it in File Explorer, and choosing 'Eraser > Erase Unused Space'.

6 SECURE MOVE

Eraser also incorporates a handy feature for moving files and folders securely. It does this by creating a copy of your data in virtual memory, securely erasing the original, and copying the file or folder to a destination of your choice.

- To make use of this feature, first open File Explorer and navigate to the file or folder you wish to move. Right-click to open the context menu, and choose 'Eraser > Secure Move' [Image D]. Eraser automatically opens a prompt asking you to select the target destination, such as a USB drive. Navigate to this and click OK. Eraser manages the copy process and securely removes data in the usual way.
- By default, Eraser overwrites drives with one pass of pseudo-random data. If this isn't sufficient to abate your paranoia, access Eraser's settings, and choose a more secure method from the drop-down menu under 'Default drive erasure method'.

7 SECURELY ERASE RECYCLE BIN

If there's content on your PC that you've deleted previously, follow the steps outlined above to erase free space on your hard drive. If, however, the files and folders you want to remove are still in your Recycle Bin, Eraser can securely move these in place. Simply right-click the Recycle Bin and choose Erase. If you've previously enabled the plausible deniability feature, note that Eraser doesn't place decoy files in the Recycle Bin. Be sure to use Eraser directly on sensitive data in future if you want to avoid scrutiny of your hard drive.

SSDs: a special case

Solid-state drives and USB sticks use flash memory.

While this works much faster than a magnetic hard drive, each sector can only be written to a finite number of times. For this reason, most solid-state devices employ 'wear leveling' mechanisms, which spread data around the drive as evenly as possible. This means the drive lasts longer, but is a nightmare from a security perspective, as most wear leveling procedures interfere with the secure erasure of data. When it comes to flash memory, there is no way to be sure sensitive data is completely gone, no matter how many times a file or folder is overwritten.

Short of incinerating your SSD or giving it an honorable burial at sea, the only way to be certain your files are safe is to employ full-disk encryption, using a program such as VeraCrypt or Microsoft's own BitLocker. If an adversary attempts to recover data from an encrypted solid-state drive, they will find only fragments of encoded data, which are useless without the correct decryption key. ■

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BUILD THE ULTIMATE HOME SERVER

Alex Cox shows how you can use enterprise-level tech to make your home network extra awesome.

Excuse us being a little excitable, but you want the best server. A server that can do it all. A single machine, ready to give you everything you need — media, ad blocking, file serving, the works. But man, what a drag it is to put something like that together — installing all the software, getting it all working with your hardware, balancing the load so that one thing doesn't completely neuter another. Nobody in their right mind would choose to do that if there were a better alternative. And there is. So while this is a look at creating

the best server, we've skewed it as a look at the right way to go about it. Once you have the tools, adding something new to your server will take literally a couple of minutes.

Even better: you don't really need any heavyweight silicon. Sure, some apps (we're looking at you and your transcoding, Plex) would like more CPU cycles than you may be willing to offer, but for the most part, you could run a server full of apps on \$35 hardware. Install the right thing, and you can keep tabs on all of the apps on your server, no matter what they are, through a single web interface,

accessible from anywhere on your home network.

So building the best server isn't about the apps. It's about being able to do it properly, finding the right enabler, and using it the right way. We'll take you through everything you need to know to construct a modern, scalable server using enterprise-class software components, without spending a cent on software. And yes, we'll suggest some awesome things you could be running on it, but this isn't our server, it's yours, to do with as you will.

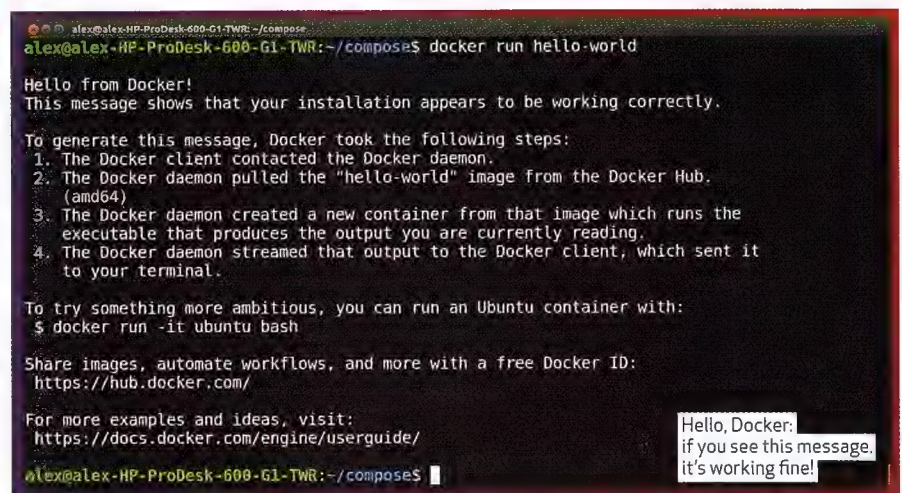
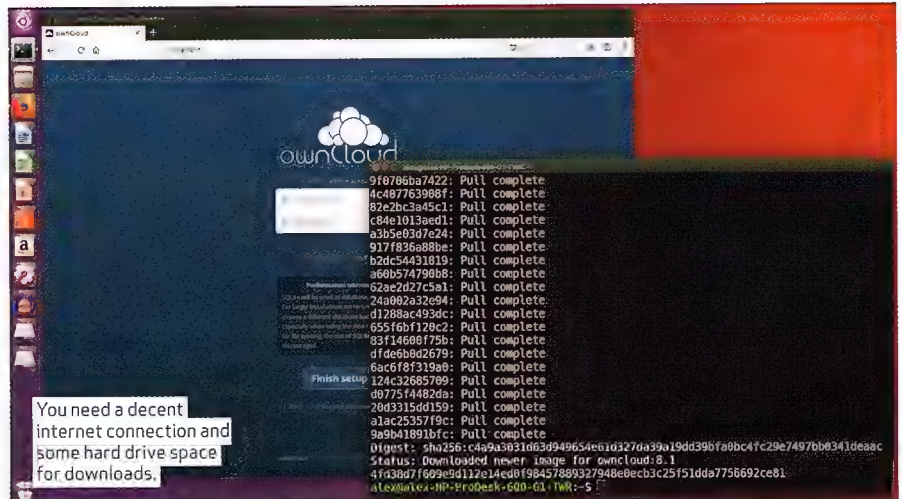
We're not going to stop you building your server in any way you see fit. If you want to install everything traditionally, and run it in the same way you'd fire up software on your desktop, by all means go ahead and do that. But in the enterprise, server technology has moved on. As chipsets improved, RAM increased and processor overheads exploded, the market moved first toward virtualisation and, more recently, toward containerisation. And why should the enterprise have all the fun?

It's important to outline the distinction between the two. Virtualisation, in the virtual machine sense, is big and heavy. It's a whole operating system in a hefty chunk, and a virtualised system either places the entire demands of an OS on its host, or is forced to scale itself back if the resources aren't available. A virtual machine relies on chipset trickery for intercommunication with shared hardware, and can get its hooks in pretty deep – it's not unreasonable to get performance close to bare metal with a VM.

Containerisation is not virtualisation in the same sense. A container isn't an OS – it's software, everything that software needs and nothing more, bundled up in a universal package. While VMs represent hardware-level virtualisation, containers act at operating system level. Each container on a system relies on an engine layer, which in turn relies on a bunch of kernel components from the base OS – so they're not entirely isolated, although they can get away with some high-level operations. They're super-lightweight, quick to roll out, and can pull off native performance without the overhead of a VM. Indeed, they'll work perfectly happily within a VM; try nesting a bunch of virtual machines inside another VM if you want to hear your hardware cry out in terror.

GETTING STARTED

If we're using containers (and, for all the options we offered, we are definitely doing that), probably the best way to look is in the direction of Docker, the platform that broke the back of the concept, and turned it into a reality. Docker is immensely popular, which means there are tons of pre-built containers available, and it scales very well, to the point where you can realistically (albeit sluggishly) containerise a Raspberry Pi (see 'Serving up Pi' over the page). We're going to run through Docker on a bare-metal Ubuntu installation; you could equally set up a VM and fill it with your own containers, if you don't have the hardware to spare, and don't



mind ignoring the point of a server. What we don't recommend is running Docker on Windows. While containerisation forms a big official part of Windows Server 2016, and there's support for it built in to the Pro and Enterprise editions of Windows 10 post-Anniversary Edition (and also through a combination of VirtualBox and Docker Toolbox), it's a lot more mature on Linux. Admittedly, we're not super-worried about too many of the specifics, or about creating our own super-bespoke containers – basically, we're using an advanced enterprise tool meant for DevOps deployment as an excuse to lazily create a home server, which is cool but not entirely taking full advantage of it. Nonetheless, we still recommend sticking to Linux, and Ubuntu is as good an OS as any.

So grab the ISO of your preferred flavour of Ubuntu, write it to a USB drive (use Rufus from rufus.akeo.ie, it's great), and install it on your server machine. Make sure, during the installation, that you include the Samba and SSH server portions, just so it's easy enough to control from another machine on your network. You'll be glad of this once your server

is disconnected from peripherals and shoved under the stairs. Once it's running, open up a terminal, and begin the process of installing the stable thread of Docker Community Edition.

GET DOCKER SET

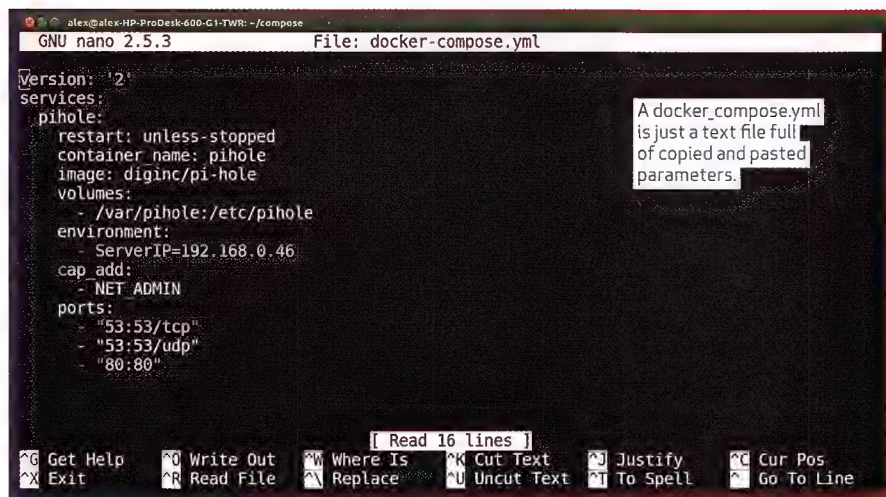
We want to grab the latest version of Docker from its own repository, but in order to do that, we need to start by installing the prerequisites for adding that repository as a source. Run `sudo apt-get update` to get your Ubuntu installation up to speed, then `sudo apt-get install apt-transport-https ca-certificates curl software-properties-common` to ensure you have all the relevant tools. Now use `curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -` to grab Docker's GPG key, followed by `sudo add-apt-repository "deb [arch=amd64] https://download.docker.com/linux/ubuntu $(lsb_release -cs) stable"` to add the repository itself. Run `sudo apt-get update` again to refresh Ubuntu's package list and, if all has gone well, you can run `sudo apt-get install docker-ce` which will pull down and install

Serving up Pi

Make no mistake, a Raspberry Pi is cheap and awesome, but it makes for a poor multi-purpose server.

It's pretty much a terrible computer, except for certain applications that don't care about its lack of system resources, and its network bus — shared with USB — is severely limited. That said, for single tasks or light use, it's great, and is the perfect candidate for a few Docker containers. As you might guess from the name, Pi-hole originated on the Pi, and is one of the best candidates; the Pi can certainly manage a little DNS flinging, and you can realistically get it installed, hide that Pi away, and never worry about ads again. CPU-light apps, or those that are occasionally used, are also fine. The version of Docker that's included with Raspbian needs a quick update before it works properly, so run `curl -sSL https://get.docker.com | sh` to install afresh.

While Docker runs fine on a Pi (far better than any traditionally virtualised solution), images are often built for X86 platforms rather than the Pi's ARM. Even the standard hello-world image won't work; to test a Pi Docker installation, you need to run `docker run armhf/hello-world`. When searching for candidates or containerisation, be sure there's an ARM64 version. Visiting hub.docker.com/u/arm64v8 brings up a number of options, all created internally within the Docker team. Or why not use your Raspberry Pi as a Tor relay with the `brunnei/tor-relay-arm` image, or install one of any number of programming environments? You could even use Deluge to set up your Pi as a hub for all your torrents, or try Pydio for a little simple online file storage.



Docker Community Edition, along with all of its dependencies.

With that done, it's time to show just how incredibly easy it is to get things running with Docker, by pulling down a complete image from its servers and running it in a container. Ready? Run `sudo docker run hello-world` and see what happens. That's it. The whole thing. Docker has contacted its servers, pulled down the image "hello-world", started a new container based on that image, and piped its output into your terminal. You've run a containerised application, however useless it may be, and you can call `sudo docker info` to prove it: It'll list one stopped container. We recommend following the steps in 'Quality of Life' (opposite) now, so you don't have to append "sudo" to the start of every command that follows.

ADDING CONTAINERS

Running other containers isn't always as straightforward as that "Hello World" example, but it's not necessarily far off. Try, for example, `docker run -d -p 80:12345 owncloud:8.1` to start a container with an image of the OwnCloud file server within, then open up a web browser on your server machine, and go to <http://localhost:12345> to see the results. It's pretty immediate, although we've had to add a few additional parameters this time. For example, `-d` tells Docker to run the container in detached mode, managing it in the background, rather than filling your console with status messages, and `-p` tells it to pass the port of the container to the host machine — `80:12345` is our port mapping, piping port '80' of the container to port '12345' of the host

machine. When you're running multiple containers with a web interface, you'll want to map them to different ports.

That image, after first running, has been cloned to your system. Reboot your machine and run `docker image ls` to list all the containers that exist on your system, and you'll see it there; run the same command as before to start it up, and Docker won't redownload it — it runs the local version instead. But now, before we start wantonly installing the apps that are going to make our server so great, it's time to up the complexity a little, and look at running and configuring a proper collection, and for that we need `docker-compose`, which combines a bunch of containers into a single application.

GOING MULTIPLE

Time for a little admin. Install Docker Compose with `sudo curl -L https://github.com/docker/compose/releases/download/1.21.2/docker-compose-$(uname -s)-$(uname -m) -o /usr/local/bin/docker-compose` (replacing that version number with the very latest version, which you can find at github.com/docker/compose/releases), then give it the permissions it requires with `sudo chmod +x /usr/local/bin/docker-compose`. Working with Docker Compose is, like its sibling, ridiculously easy. Basically, you need to build a configuration file that tells it which containers you want to run, and feeds in the parameters they need to operate properly, then it goes off and does its thing. To make that even more simple, most applications offer a template for precisely what needs to go into the configuration file, and all you need to do is fill in the blanks. So let's walk through a simple Docker Compose installation, using ad-blocking DNS manager Pi-hole as an example.

To do so within Docker Compose, you first need to generate the configuration file; make a new directory for it with `sudo mkdir ~/compose`, and change to it with `cd ~/compose`. Create a working folder for Pi-hole with `sudo mkdir /var/pihole`, give it permissions using `sudo chown -R <your username>: <your username> /var/pihole`, then run `sudo nano docker-compose.yml`, and enter the following into the file, switching "LANIP" for your server's IP address, and paying special attention to the spacing — each tab should be two blank spaces:

```
version: '2'
services:
  pihole:
    restart: unless-stopped
    container_name: pihole
```



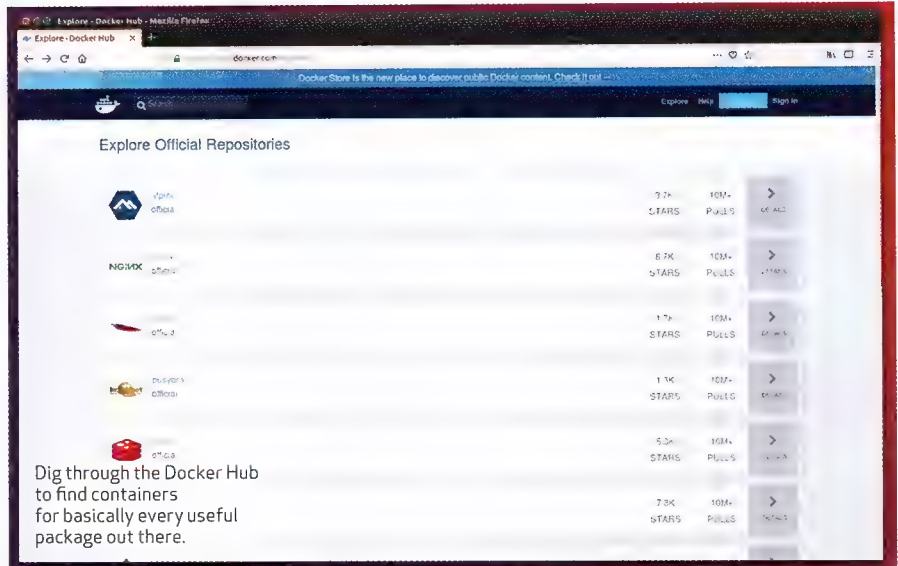
```
image: diginc/pi-hole
volumes:
  - /var/pihole:/etc/pihole
environment:
  - ServerIP=LANIP
cap_add:
  - NET_ADMIN
ports:
  - "53:53/tcp"
  - "53:53/udp"
  - "80:80"
```

Now just run `docker-compose up -d`, and Pi-hole should be up and running – if not, it could be conflicting with another process (such as `dnsmasq`) that takes control of port 53. To kill that, run `sudo sed -i 's/^dns=dnsmasq/#&/' /etc/NetworkManager/NetworkManager.conf` to remove it from the relevant config file, then `sudo service network-manager restart` / and `sudo service networking restart`, followed by `sudo killall dnsmasq` to make sure it's really, truly dead. You can check your results by heading to <http://localhost/admin> in a web browser. Adding further containers to your combined application is just a case of adding their parameters to the `docker-compose.yml` file, then running it again. To use Pi-hole's DNS sinkhole facilities properly, you now need to configure your router to route DHCP clients through your server.

THE POWER PACK

So that's the how. What about the what? Start digging through hub.docker.com, because just about everything you could possibly want has been put in a neat package for you. File management, for example: OwnCloud, as mentioned before, offers up a Dropbox-esque way of managing your files, with a web interface that offers simple password-protected access to a bin of files from every device in your home – including mobile clients. Nextcloud does much the same job as OwnCloud, but if you'd like to go more raw, you could fire up an SFTP server (try the `atmoz/sftp` image), or containerise a Samba installation (`kartoffeltoby/docker-nas-samba`) to give your server fuss-free NAS capabilities.

Media next, and you're spoiled for choice. Plex, using the officially sanctioned `plexinc/pms-docker` image, is our top choice for home (and beyond) media server duties, but you don't have to run it alone. There are various tools that can enhance your media-getting capabilities, although we can't say too much about them here. Head over to linuxserver.io and check out the most-downloaded images if you'd like to see which are the most popular. Once you're all lined up, be sure to add the excellent `linuxserver/plexpy`,



which helps you keep tabs on precisely what's going on with the traffic and files running through your Plex server. The back end portion of Kodi is also a solid choice, although in our opinion, Plex is a much more adept file-wrangler.

Your server could perform more esoteric archiving and organisational duties, too. Try Mediawiki to get an instant home wiki up and running, perfect for recording significant information, or Photoshow (`linuxserver/photoshow`) to quickly install a database-free photo gallery with drag-and-drop uploading. Vault (`vaultproject.io`) isn't pretty, but it's a great place to hide secrets, giving you a sealable safe for passwords, keys and other critical security information.

Home Assistant (`/homeassistant/home-assistant`) can, after a bit of wrangling, take control of all your smart gear in one place.

MAKING IT EASIER

Once you start piling on the containers, make sure you manage them (and their increasingly irritating port demands) well – see 'Managing multiple containers' over the page. And although putting together a `docker-compose.yml` isn't taxing, you can get more granular control over containers with Portainer (`portainer.io`), which throws up a web interface in which you can start, stop, or add new containers at will. Organizr (`/lsiocommunity/organizr`) is also useful, pulling all your media server apps into a single

Quality of life

Tuning a Docker server? You'll want to be as hands-off as possible.

That means giving Docker slightly more access, but on the flip side, it means a slight reduction in security, so it's up to you if you wish to follow these steps. First, create a new group just for Docker by using `sudo groupadd docker`, then add your current user to the `docker` group with `sudo usermod -aG docker $USER`. Log out, then log back in, and you should now be able to run Docker commands (try `docker run hello-world`) without prepending them with "sudo". If you see an error, it's probably a permissions issue with your `~/docker/` folder, caused by using "sudo" previously; you can either kill your existing folder with `rm -f ~/docker/` and start again, or give the folder the appropriate permissions, first with `sudo chown "$USER":"$USER" /home/"$USER"/.docker -R`, then with `sudo chmod g+rwX "/home/"$USER"/.docker" -R`. Make sure you offer similar permissions to other folders you create, for storing data or media in your containers.

It's handy to have Docker run automatically upon boot, so you don't need to grab your peripherals (or log in via SSH) to get your server back up and running if you power cycle. Just add Docker to Systemd, the Linux component that (in most modern distributions) deals with managing the processes that run at boot time, by running `sudo systemctl enable docker` within your command line. Type `systemctl` to check it's worked – dig through the list until you see "docker.service" listed. If you ever change your mind, you can reverse the action with (you guessed it) `sudo systemctl disable docker`.

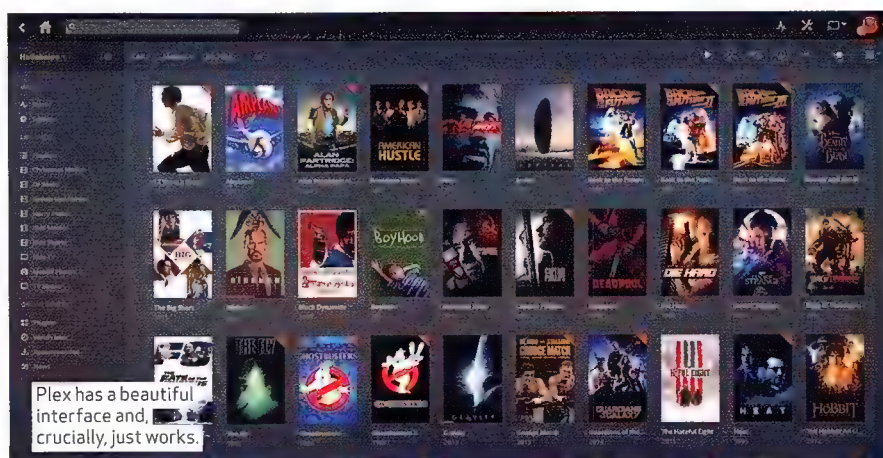
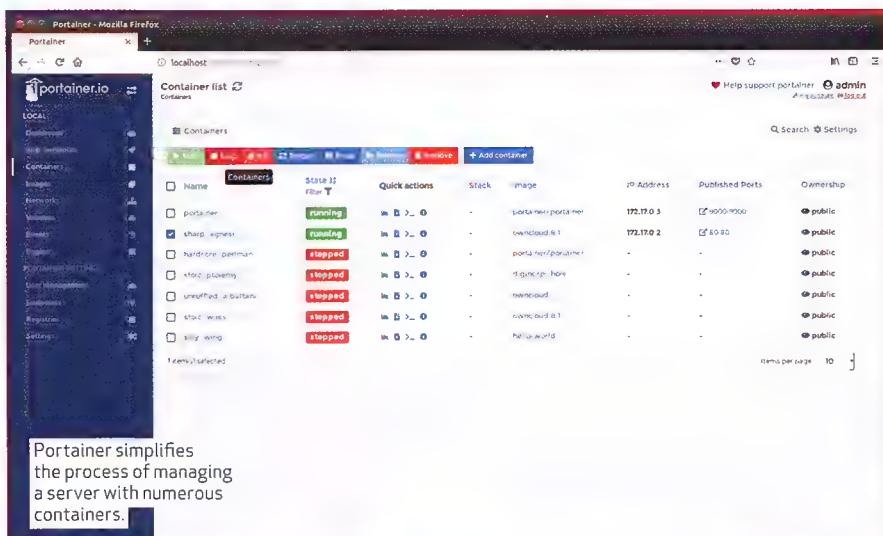
Eventually, you're going to find your server lacking ports.

might take you to your Plex server without the need to remember which port it's living on. Nginx can also take charge of load balancing and traffic management between your server containers — check out github.com/jwilder/nginx-proxy for information on getting it running, and look at installing dnsmasq (hub.docker.com/r/strmr/dnsmasq) within a container to deal with local DNS remapping.

The screenshot displays the Netdata live dashboard for a server. The top navigation bar includes links for 'Home', 'Alerts', 'Summary', 'Updates', 'Help', and 'Log'. The main section is titled 'System Overview' and features several circular gauges for CPU, Memory, Disk, and Network usage. Below these, there are detailed graphs for CPU, Memory, Disk, and Network usage, each with a 'load' section. The CPU graph shows a significant spike in usage, while the Memory graph shows a steady increase. The Disk and Network graphs show relatively low usage. The bottom of the dashboard includes a 'load' section with a graph showing system load over time. A text box at the bottom left of the image contains the text: 'Netdata's live graphs and alerts give a total picture of your server's health.'

well-explained look at the deeper aspects of your server hardware. If something's not working as it should — or even if you have a minor driver issue — you'll know about it first.

If, rather than making things easier, you'd like to make them slightly more difficult, but a lot more personal, look into creating your own containers. It's complex, but Docker's documentation covers the process in a huge amount of detail — head to docs.docker.com to learn about the required components and relevant commands. Once you've made your own container, upload it to the Docker hub, where anyone (including future-you) can pull it back down to their own machine, and replicate it exactly. ■



how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

APPLICATIONS

BUILDING A PORTABLEAPPS TOOLKIT

I'd like to install PortableApps and build my own toolkit. Do you have any tips or pointers for which apps I should include?
Frank Plunkett

First, download and install the PortableApps platform (available from portableapps.com) on a different drive or partition to Windows if you can; however, if you have a non-partitioned SSD on which Windows is installed, install the app in a folder inside your user folder, making sure that the folder is synced to the cloud using OneDrive or a similar service so it can be easily restored following a crash or reinstall (plus shared on any other PCs you have).

Once installed, go through the extensive list of apps provided and add those you want. Other portable apps can also be incorporated by extracting them into a folder inside the main PortableApps sub-folder and choosing 'Apps > Refresh App Icons'. Finally, these programs will appear under the Other category – take the time to right-click the program shortcut and move them to the category you want.

Mayank Sharma

NETWORK

PROTECT NETWORK WITH OPENDNS

I understand that I can use DNS settings to secure my computers at the network level. How do I do this?

Craig Jarvis

OpenDNS (www.opendns.com) offers several ways in which you can both improve security and performance across your entire network. For it to apply to every device on your network, log on to your router through your web browser and go hunting for its DNS settings – these may be on their own tab, on the main screen or under the DHCP settings. For basic OpenDNS, set the primary DNS to 208.67.222.222 and the secondary DNS to 208.67.220.220 respectively. This should deliver



noticeably faster response times when accessing web pages. Some protection is built-in, but if you're happy to apply a network-wide pornographic filter, set the router's DNS settings to 208.67.222.123 and 208.67.220.123 instead. Now all adult content will be blocked automatically from all connected devices. If that's a step too far, leave the basic OpenDNS settings in place and sign up for OpenDNS Home Free at signup.opendns.com/homefree – once done,

you can log in and set up custom filters utilising over 50 different categories. Set up your home network, then choose a basic filtering level: High, Moderate, Low, None and Custom are all available.

Work through the various options for protecting your network from malware and botnets to phishing. Finally, if your public IP address changes over time, tick Dynamic IP Update under Advanced Settings and download the Dynamic IP Updater client on a PC that's on 24-7, so changes are automatically forwarded on to your account; otherwise you'll need to log in whenever the IP changes to continue being supported.

Mayank Sharma

SOFTWARE

AVAST UNINSTALL ISSUES

I accidentally installed Avast, which I didn't want. I used IObit Uninstaller to remove it, but it stayed and took control. I used the company's own uninstaller in safe mode but it disconnected me from the internet. It doesn't allow me to delete it from the Registry. I've tried a program called Revo Uninstaller, but that didn't find the program at all. Any ideas would be welcome.

David Horrocks

It's possible IObit Uninstaller has messed something up during its attempt to uninstall Avast. We'd try reinstalling Avast from scratch, then try again with the company's official uninstaller to remove it: www.avast.com/en-au/uninstall-utility.

After checking back with David a few days later, he reported that he re-used the Avast uninstaller outside of safe mode, which appears to have removed everything this time.

Dan Gardiner

INTERNET

BEST INTERNET ACCELERATOR

I would like to speed up my broadband connection. What's the best free internet accelerator tool for Windows?

Peter Claxton

Internet accelerator tools basically attempt to tweak various system settings to fine-tune network and internet performance. They won't have any effect on your physical connection, but you may find they have a minor performance benefit (it's unlikely you'll see major improvements, however). We could only find one free tool — Internet Accelerator, which you can download from www.pointstone.com (look under 'Software > Freebies'). Although Internet Accelerator will run on Windows 10, it's not been designed for it; we recommend trying it on older versions of Windows, and take a System Restore point or drive image first, just in case it makes things worse and the Restore Defaults option doesn't work.

Rob Mead-Green

WINDOWS

UPDATE CRIPPLED USER ACCOUNT

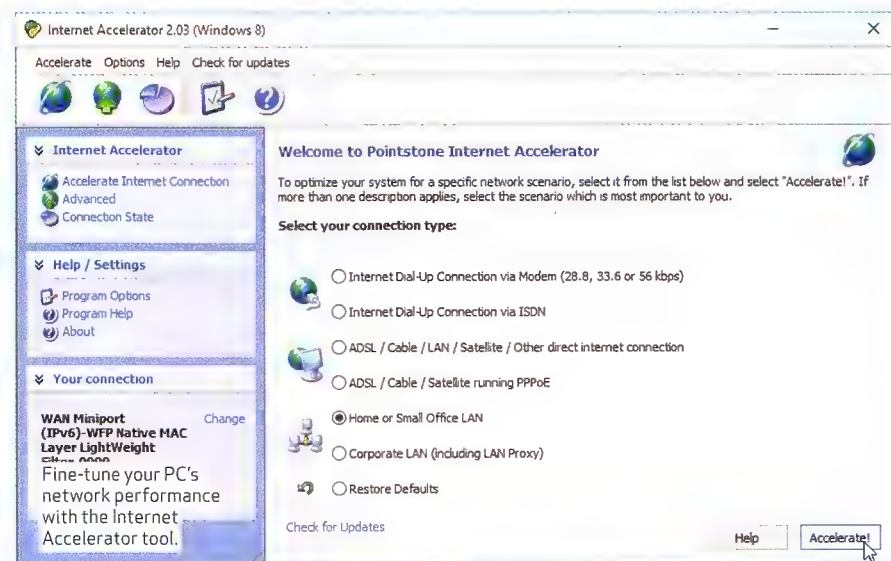
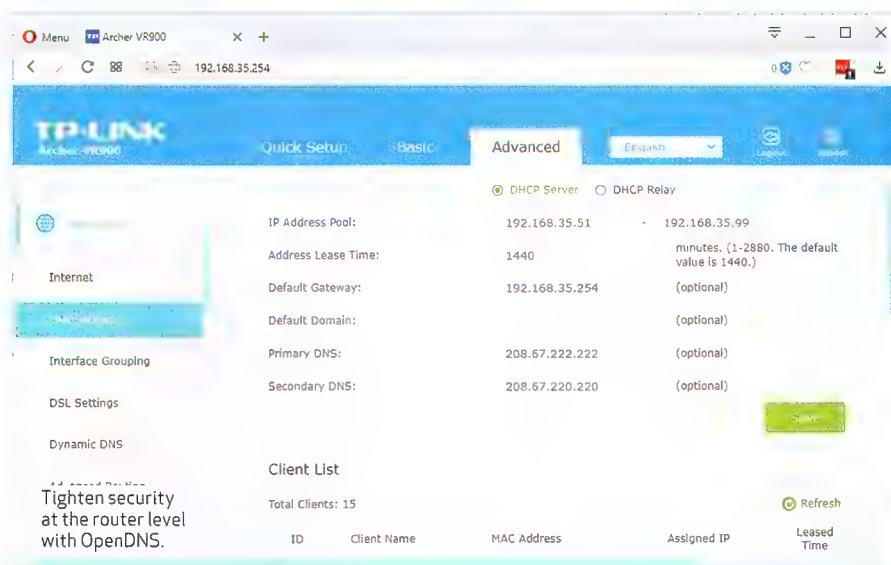
My main — and only administrator — user account has lost key functionality after a Windows feature update: no Start menu, search facility, library files or drive access. I've tried various solutions, and even performed a refresh install, but it hasn't fixed the problem. Strangely, my wife's non-administrator account is unaffected. Can you help?

Kevin Riddick

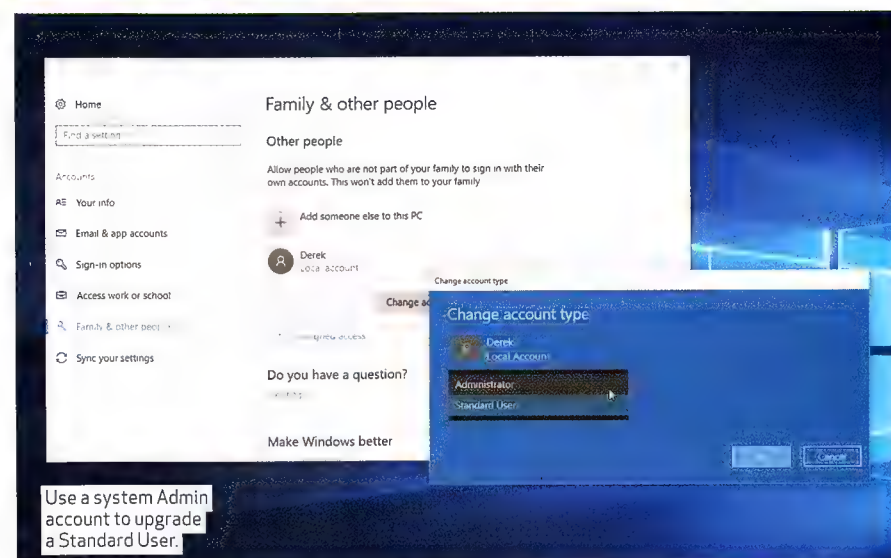
Kevin had managed to create another user account, but it was a standard user, with no apparent means for elevating to administrator. Thankfully, this can be done by temporarily enabling the system Administrator account. First, while logged into your non-administrator account, right-click the Start button and choose 'Command Prompt (admin)' or 'Windows Powershell (admin)'. Enter the password for your corrupt administrator account, then type the following command: `net user Administrator /active:yes`

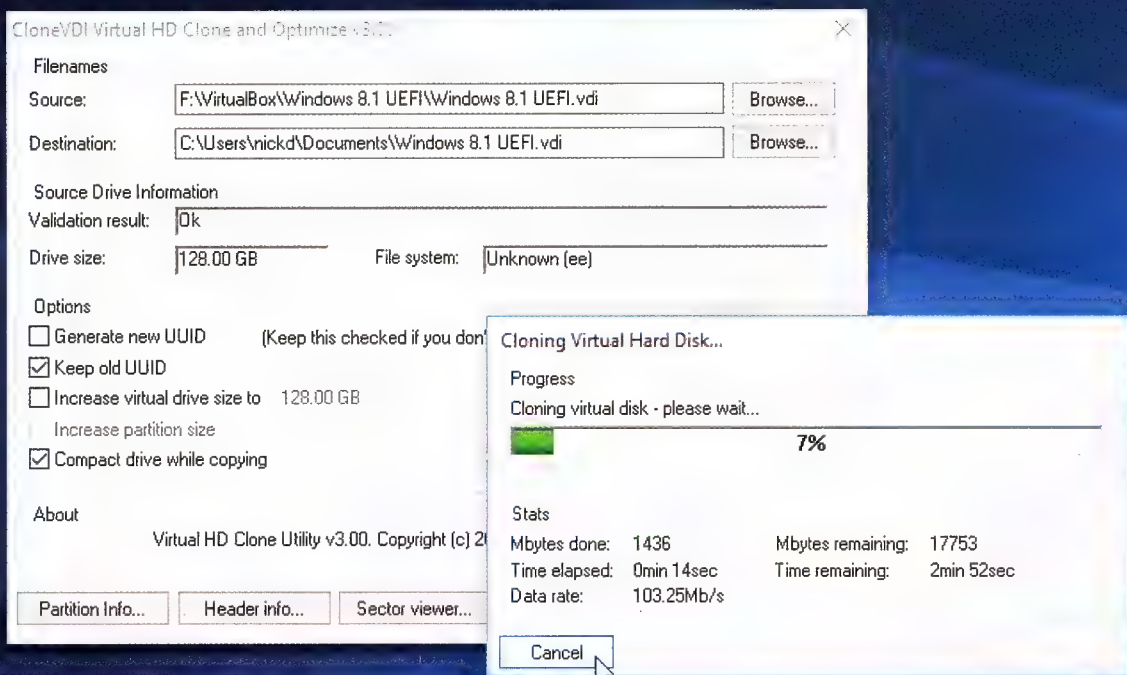
Close the command prompt window, then log out. You should see a new Administrator account appear, select this to log in (it's not password-protected). Now go to 'Start > Settings > Accounts > Family & other people'. Select your new account and click 'Change account type'. Select Administrator and click OK. Log out of the Administrator account and back into your new account — click 'Start > Settings > Accounts > Your Info' to verify the account is now an administrator one. You can now open another Command Prompt (admin) window and type: `net user Administrator /active:no`

Once you've transferred any files



"I accidentally installed Avast, which I didn't want. I used IObit uninstaller to remove, but it stayed and took control."





Be sure to tick 'Compact drive while copying' to save space with your cloned drive.

or settings across from your old user account to your new one, you can then delete the old account.
Nick Peers

WINDOWS

BEST REINSTALL METHOD

I'm about to install the Windows 10 Fall Creators Update having decided to reinstall Windows from scratch following your guides. Should I reinstall Windows 10 first and then apply the update, or should I reinstall after I've done the update first?
Adam Griffin

Why not do both at the same time? Download the latest version of the Media Creation Tool from www.microsoft.com/software-download/windows10 and use it to create a fresh Windows 10 installation DVD or USB flash drive. Use this to install Windows 10 with the Fall Creators Update included following one of our recent guides. Doing so means you'll have a fresh system with the latest version of Windows on it.
Cat Ellis

SOFTWARE

CLONE AND COMPACT VIRTUAL HARD DISKS

I'm running out of space on my VirtualBox partition, where I keep multiple virtual machines. Can I reclaim drive space without moving them?
Craig Hurst

Onboard Ethernet port playing up? Simply swap it out for a PCIe card.



There are two different techniques we'll look at – start by browsing to forums.virtualbox.org/viewtopic.php?t=22422 where you can download and extract the portable CloneVDI tool. Then follow these steps:

- Virtual machine snapshots take up a lot of space. Delete the ones that you no longer need by right-clicking a snapshot and choosing Delete – their changes will be merged into the current state or the next snapshot in a chain.
- Over time, your virtual disk files will become bloated – by cloning the disk using CloneVDI, you can opt to compact them by removing

all unnecessary space. Launch CloneVDI and click Browse to select your source hard disk file.

- Click 'Browse...' to choose a different folder or drive. Make sure that the name of the file matches the original. Tick 'Keep old UUID' and 'Compact drive while copying' on the main screen. Click Proceed and wait for virtual disk file to be cloned.
- Once complete, check that the new file is smaller than the old file. If it is, move the original out of its folder, then move the cloned file in. Close and restart VirtualBox and test to see if the clone works correctly; if it does, you can discard the old file.

Rob Mead-Green

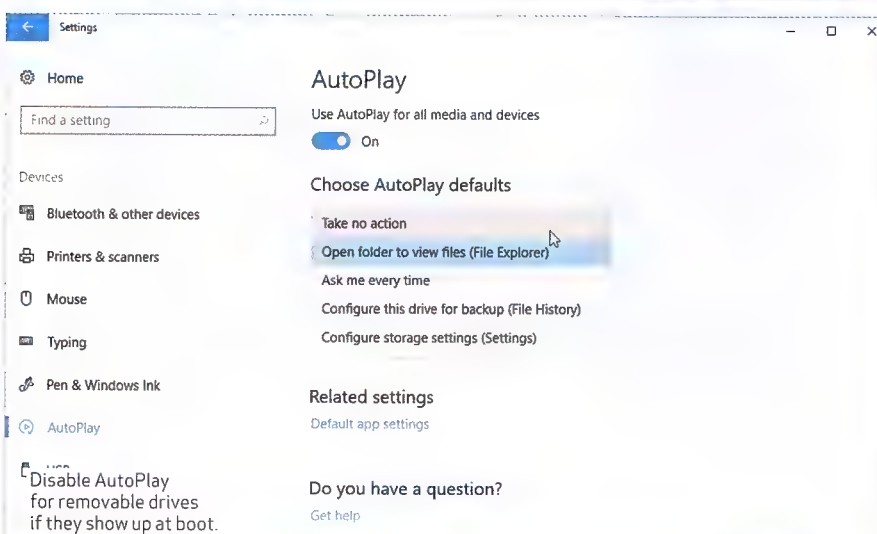
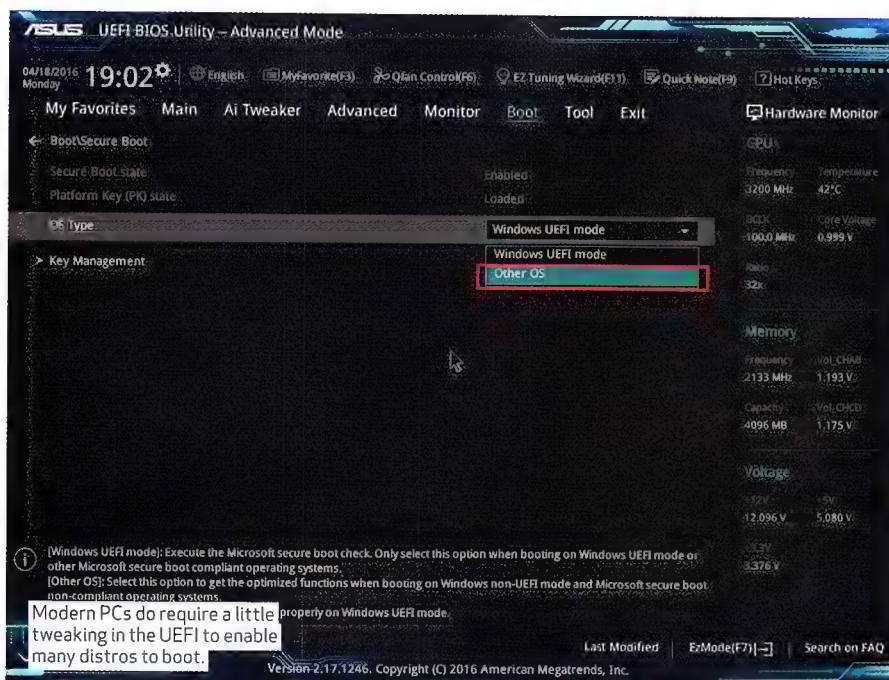
HARDWARE

FLAKY ETHERNET CONNECTION

Since upgrading to fibre broadband, my PC's Ethernet connection has kept dropping out. I have a Wi-Fi adaptor, which works fine with it, and none of my other Ethernet-connected devices have any problems. What's the cure?

Tom West

This could be either a driver problem or a hardware glitch. Tom tried a different Ethernet cable as well as router port, all to no avail, plus verified he had the latest drivers installed. The upgrade to fibre appears to have been coincidental, although the act of plugging the PC's Ethernet cable into a new router may have triggered or exacerbated an underlying issue.



Tom revealed that his Ethernet port — which was part of his PC's motherboard — did wiggle when touched, which suggests a loose connection caused by a dry solder joint. Tom wasn't confident with a soldering iron, but he had a spare internal PCI-Express slot, so we directed him towards the TP-Link TG-3468 PCIe Gigabit Ethernet card (bit.ly/2hTDMZQ), which is available for around \$14 online. Installing and using this resolved Tom's connection problem. **Mayank Sharma**

LINUX VERY INSECURE
I've just had a new computer made and ordered without an OS so that I can install Ubuntu. But it has come with Secure Boot enabled in the UEFI bios. The facility to turn it off is greyed-out so I cannot change it. The motherboard is ASUS H110M-R: Micro-ATX. There is a facility for running legacy software, but Ubuntu will not run with UEFI enabled. Ubuntu is configured to ignore Secure Boot, and runs in "insecure mode". The problem is that

other Linux discs will not run in the DVD drive. Is there a way of turning off Secure Boot?
Bryan Mitchell

As you've discovered, only a small number of Linux distros have the correct keys to support Secure Boot; Ubuntu being one but also Fedora and openSUSE. Most others don't and so won't be able to run on any PC that has this applied. It's not an evil conspiracy to kill Linux, it's a security feature, but obfuscated options like this don't help.

ASUS does provide a way to disable it, though, and the process is loosely this: enter the UEFI, select 'Advanced Mode Menu > Boot > Secure Boot'. Change the OS option from Windows to 'Other OS', which should mark the Secure Boot keys as unloaded. The UEFI won't usually be the issue, as the GRUB2 boot loader handles passoff from this.
APC team

WINDOWS FOLDER WINDOWS APPEAR ON STARTUP

Some weeks ago — and with no apparent reason — Windows started opening folder windows on startup. It doesn't happen every single time Windows loads, but I consulted some online experts who copied and pasted some code to make changes to the Registry. I'm a little wary of this as the instructions were rather vague. Can you assist please?
Ian McAndrew

We instructed Ian to first verify the problem wasn't linked to any start-up programs. To this end he installed BootRacer (www.greatis.com/bootracer) and enabled Startup Control. This not only lists start-up programs as they're being loaded, it implements a 10-second delay before starting them to give Windows time to finish setting itself up. The windows all appeared during this initial delay, which indicated that the problem was with Windows itself.

There are a few Registry entries that — if altered incorrectly or missing — can cause File Explorer windows to appear. But even after correcting these, Ian was still plagued with three pop-up windows, all pointing to different external hard drives. Ian checked 'Start > Settings > Devices > AutoPlay' and set the default AutoPlay behaviour for removable drives to 'Take no action'.

On rebooting Windows, the three remaining pop-up windows completely vanished.

Mayank Sharma

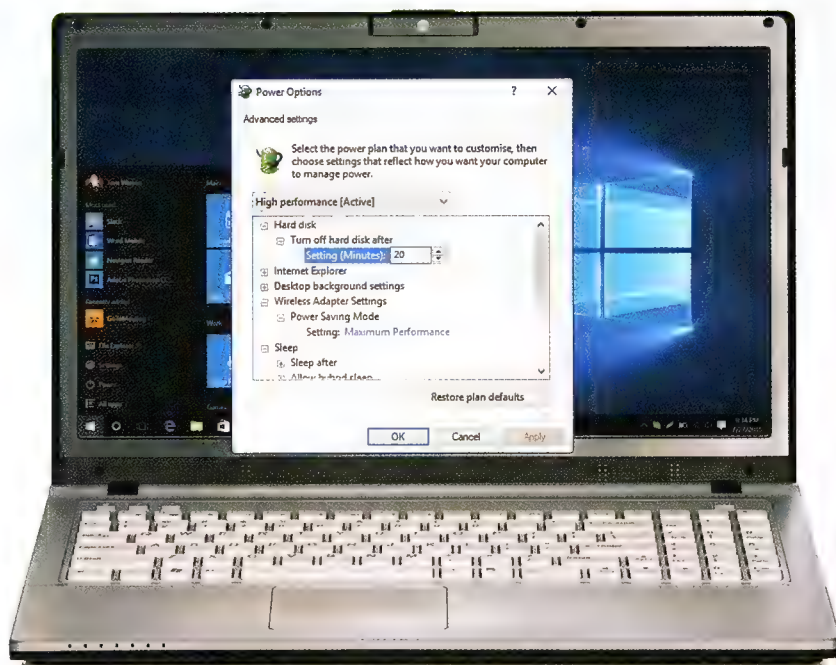
Control your Windows PC's power use

If you don't need your PC to run at full power all the time, you can control how much energy that it uses. Ian Evenden reveals how.

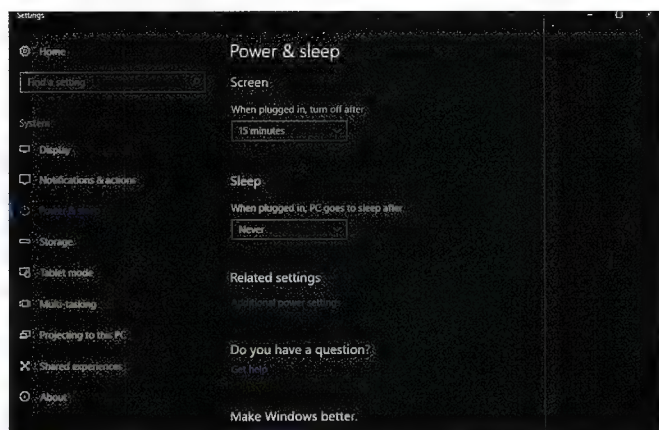
Modern PCs can use a lot of electricity. The power supply in a desktop can potentially draw over a kilowatt, especially if the PC was built with gaming or 4K video editing in mind. You don't need that if you're surfing the web or preparing a few word processing documents, however, and that's where Windows' power management options come in.

Laptops use less power than desktops, but when on the move, you need to conserve your battery life, and power saving can help. Not only can you specify when your PC will go to sleep, or hibernate, but you can also dig deep into the settings to restrict your processor's maximum frequency or when your hard drives stop spinning to save power.

If that sounds a bit technical, Windows already has some power plans built in, so you can easily switch between high performance and power saving with just a few clicks.



Take the power back



1 USE POWER & SLEEP SETTINGS

In Windows 10, pop up the Start menu and type "power", and look for 'Power & sleep' in System Settings. Click on this, and a window will appear enabling you to alter the settings. Choose how long you'd like to leave your PC idle before it goes to sleep or turns off its screen. If you have a laptop, you can have different settings for battery power or when plugged in.

> All Control Panel Items > Power Options

Choose or customise a power plan

A power plan is a collection of hardware and system settings (like display brightness, sleep, etc.) that manages how your computer uses power. [Tell me more about power plans](#)

Preferred plans

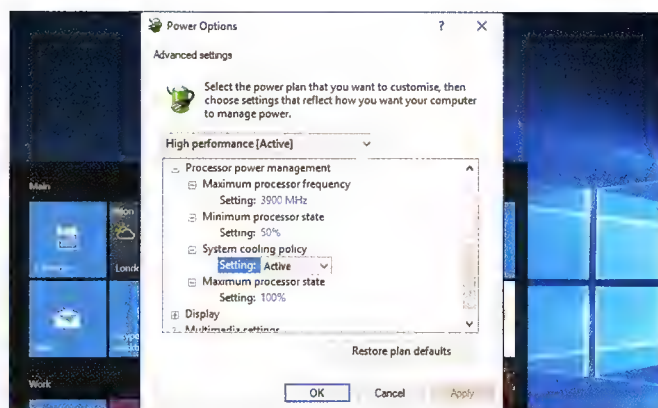
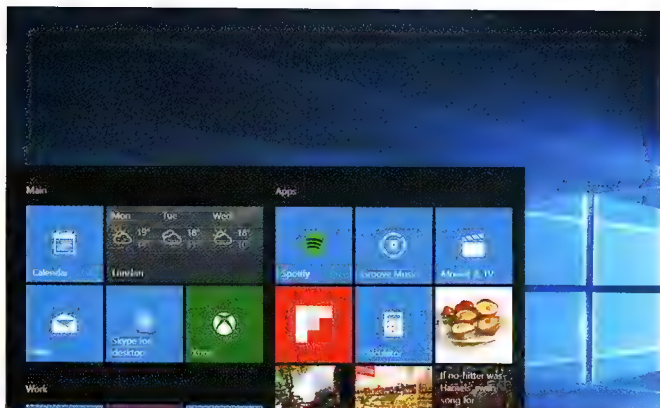
- ☐ **Balanced (recommended)** [Change plan settings](#)
Automatically balances performance with energy consumption on capable hardware.
- ☒ **High performance** [Change plan settings](#)
Favours performance but may use more energy.

Hide additional plans

- ☐ **Power saver** [Change plan settings](#)
Saves energy by reducing your computer's performance where possible.

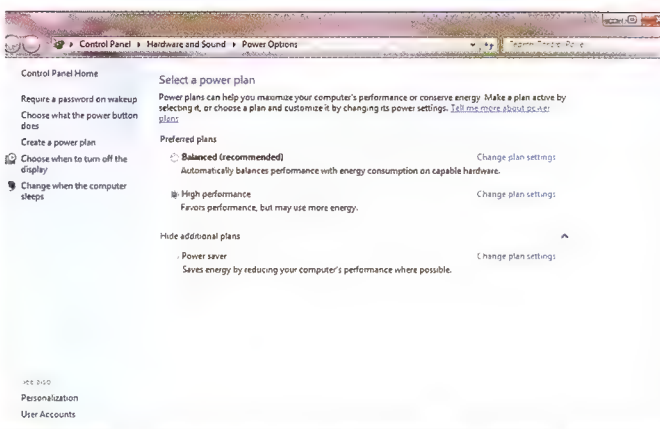
2 ADDITIONAL POWER SETTINGS

Click the 'Additional power settings' link to be taken to the Power Options window. Here, you can choose between Windows' preset power plans: Balanced, High performance and Power saver. If you're playing games or editing video, you'll want High performance. If you're trying to eke out every last bit of battery life, choose Power saver. Most people should choose Balanced.



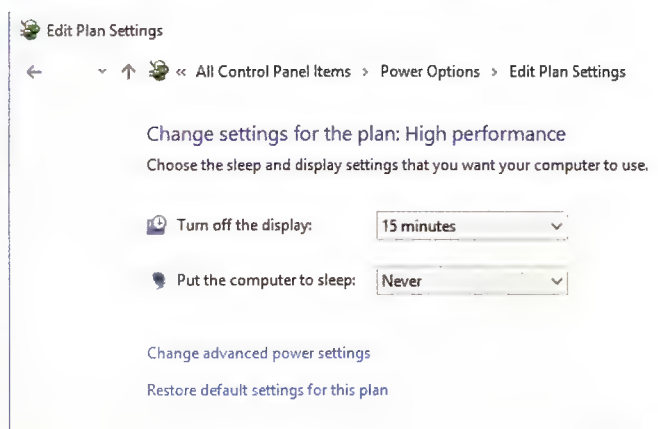
3 ADVANCED POWER SETTINGS

Click 'Change plan settings' on any plan to be taken to a new screen, then click 'Change advanced power settings'. An options window will appear. The most interesting items here are probably 'Power buttons' and 'lid' which changes what the PC does when its power button is pressed or its lid is closed. 'Multimedia settings' lets you set the level of processing power used for video playback.



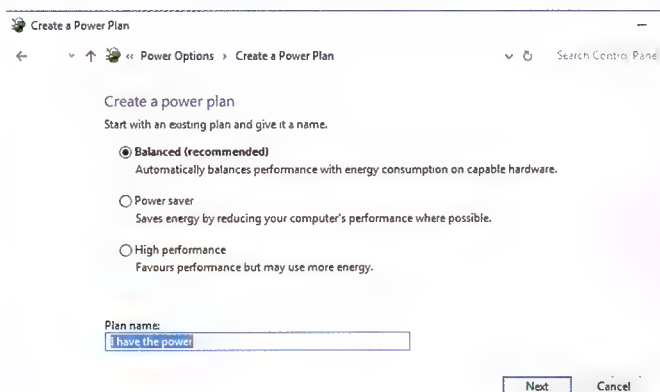
4 PROCESSOR POWER MANAGEMENT

You can also tinker with the settings for your processor's power management. Intel and AMD make a lot of their CPUs' ability to manage their own speeds and power consumption, so only do this if you know what you're doing. If you do, you can set the maximum processor frequency and change other settings from the 'Advanced settings' window. Proceed with caution.



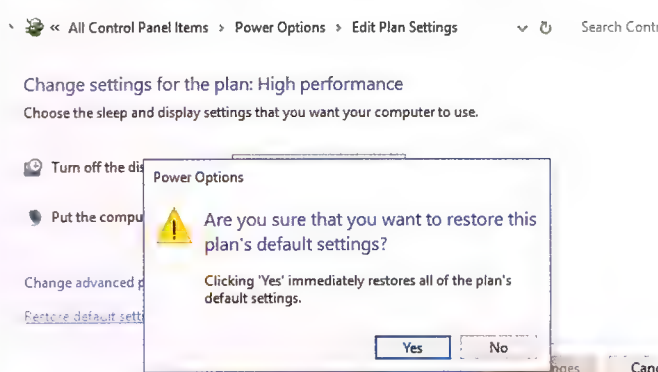
5 IN WINDOWS 7

If you're still using Windows 7, you'll find it has a similar approach to power management, but the settings for it are in a different place. You'll find the options in 'Control Panel > Hardware and Sound > Power Options', or you can search for "power settings". You'll see the same three power plans as Windows 10, and you can click through to the 'Advanced settings' window, too.



6 CUSTOM PLAN

If any of the three built-in plans aren't to your taste, you can either change them or create a new one. To change existing plans, use the 'Change plan settings' link to the right of the plans in the Power Options window. Your choices are limited to screen timeout and how long it takes for the computer to enter sleep mode, unless you want to tinker with the Advanced settings.



7 CREATE YOUR PLAN

At the left of the Power options window in Windows 10, you'll see a link marked 'Create a power plan'. Click it, and you'll be asked to select one of the three existing plans to use as a template, and to give your new plan a name. Click Next, and the display off/PC sleep time drop-downs appear, so you can choose how long your PC will stay on. Click Create to save your new plan.

8 RESTORE DEFAULTS

You can tinker with any of the power plans, and make some deep changes using the Advanced settings, but there's always a way back, whether you've been fiddling with a built-in plan or a custom one. At the bottom of the Edit Plan Settings window, there's a link marked 'Restore default settings for this plan'. Clicking it does exactly what you'd expect. ■

Pro colour management on Mac

Adam Banks explains how to ensure your digital colours always look the same...

When you take a photo, the image is generated by detecting photons striking a silicon CCD, using red, green and blue filters to capture colour. When you view the photo on your iMac, it's displayed by shining a backlight through IPS LCD RGB subpixels. After tweaking the RGB values in a photo editor, you can print it using dots of cyan, magenta, yellow and black (CMYK) inks, which each absorb different wavelengths.

These are all different processes, and each piece of hardware will differ from others, even if based on the same technology. Yet the photo looks the same throughout. There's a lot

of colour science making that happen.

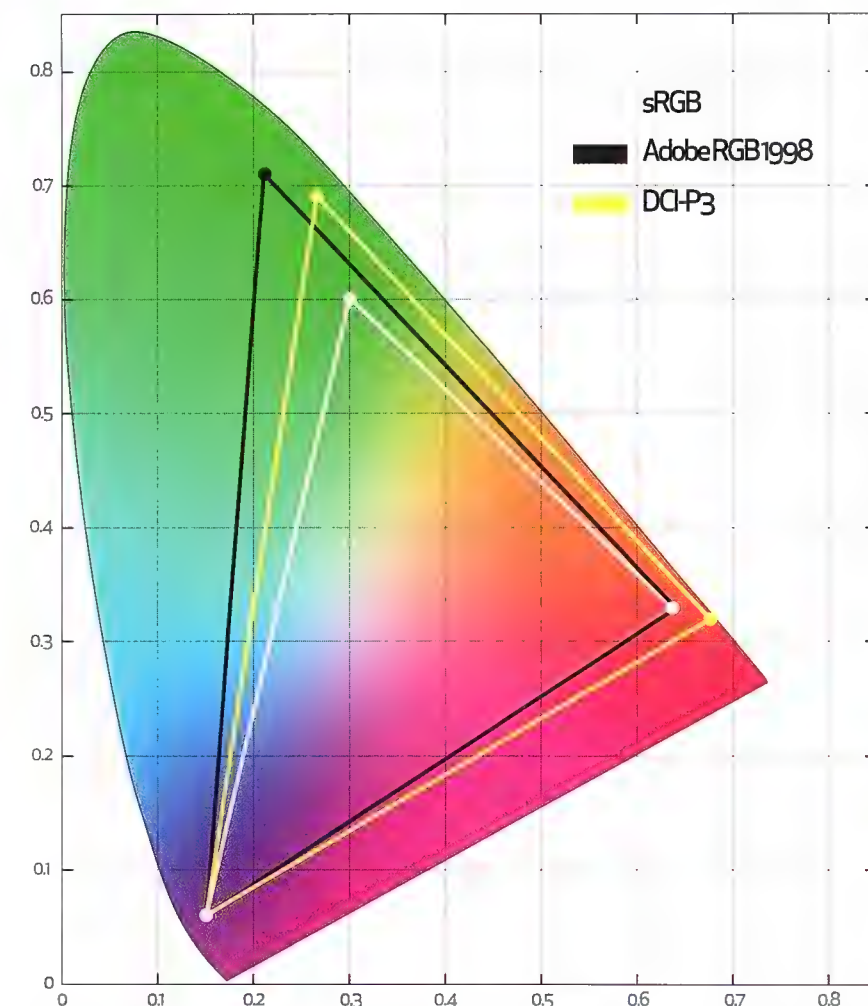
SQUARING THE CIRCLE

For thousands of years, philosophers worked on models of colour that assumed it had the perfection of geometry. Spoiler: it didn't.

After key discoveries in the 19th century about human vision by Thomas Young and Hermann von Helmholtz, in the early 1900s, Prof Albert H Munsell came up with the first proper model of the colours we actually see. He painted patches of each hue



The profile supplied with your display (or Mac) should work fine, but a calibrator like Datacolor's Spyder5 Express (about \$220) can improve accuracy.



Adobe RGB and DCI-P3 can reproduce a larger range of colours than sRGB.

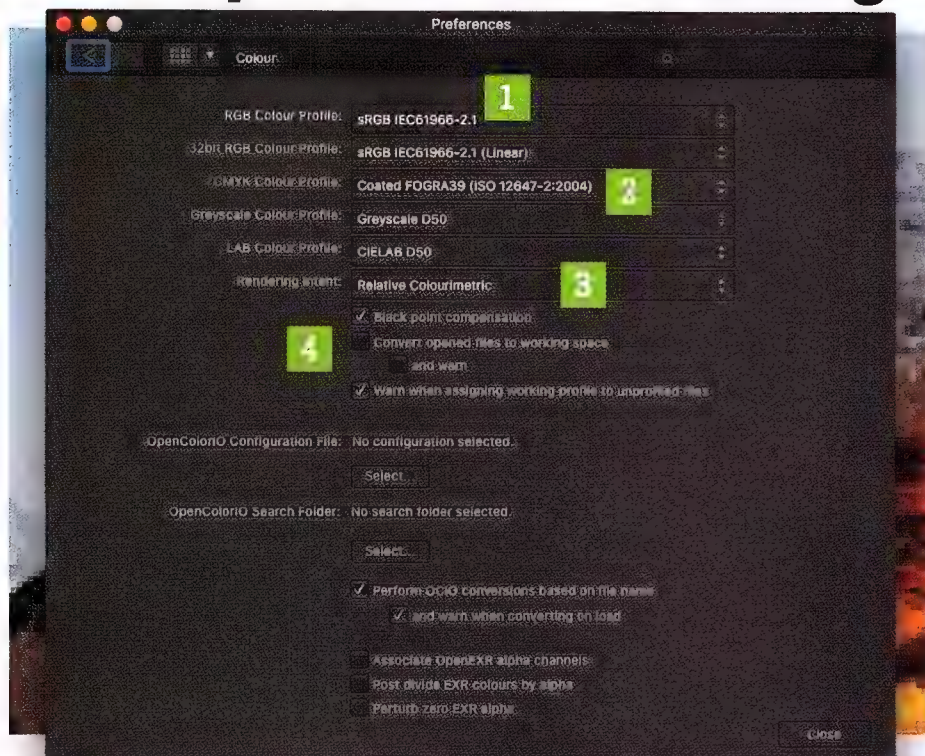
(colour of the rainbow) with steps in value (brightness) and chroma (saturation), then, by asking people which ones looked equal, arranged them according to 'perceptual uniformity'. The result was a lumpy blob. CIE colour gamut diagrams (see below) are a 2D version of this. A colour space is the blob, or gamut, of colours that a system can reproduce, or a device-independent space, such as sRGB.

Formulae specified by the International Colour Consortium (ICC) convert between colour spaces. Numbers that represent colour are only meaningful in terms of a colour model, so ideally, an ICC profile should be stored with each image – otherwise whatever device reads it has to guess. For images on the web, though, we don't want any unnecessary bytes. So web designers save images in sRGB but without a profile, and web browsers assume they're in that space.

ROOM WITH A VIEW

Saving an image in a colour space imposes limits on its fidelity, and the colour space in which your editing software works affects the accuracy of your edits; pushing colours outside the gamut will clip information. So you should aim to work in a suitably large colour space. The most popular

Affinity Photo colour management settings



1 RGB WORKING SPACE

Don't pick your display's profile here. Use sRGB or Adobe RGB for print, or DCI P3 for video.

2 CMYK WORKING SPACE

Pick a press profile as preferred by your printer, such as US Web Coated (SWOP) v2 or Coated FOGRA27 (or 39).

3 RENDERING INTENT

This governs how colours are converted. The Relative Colorimetric setting is best for most purposes.

4 CONVERT OPENED FILES

Tick this if you often receive files with odd profiles or different from your intended output.

working space for print designers is Adobe RGB (1998), which extends sRGB at the blue-green end, while video editors have used Rec709 but are moving to wider spaces like DCI P3 and Rec2020.

Premium smartphones, tablets and displays today cover all of the sRGB gamut, while cheaper displays usually manage at least 70%. Within a space, colours may be mapped more or less accurately, expressed as a Delta E value: below 1 is excellent, below 2 is decent. As colour technology improves, wider gamuts are getting more common. Apple has adopted P3 for recent iMacs, iMac Pros and iPad Pros.

A wider-gamut screen means you can edit photos and videos more confidently and see the benefit of HDR (high dynamic range) content, but it can also bring problems. Software that assumes images are sRGB will make colours too vivid in P3. And although these displays cover more of the Adobe RGB gamut than before, quite a lot of it falls outside P3. Here, though, we're into distinctions that even many pros find esoteric.

In editing software, your working RGB space should be a generic space such as sRGB, not a display or printer profile. Many designers will prefer Adobe RGB. Save your work in the same space, with a profile; copies can be saved as sRGB if necessary. The display profile set in 'System Preferences >

"Each piece of hardware will differ from others, even if based on the same technology."

Displays > Colour' should take care of on-screen colour.

RESPECTING PROFILES

iOS also manages colour, and app developers are encouraged to use profiles and cater properly for screens that use the P3 colour space, so colour should 'just work'. On both macOS and iOS, Safari now respects display profiles and will make images that are assumed to be sRGB appear correctly on wider-gamut displays.

If you work in CMYK for print, a CMYK 'press characterisation' such as Coated FOGRA39 can serve as both working space and press profile. With photos, though, you'll normally work in RGB and convert to a CMYK profile on output.

Larger colour spaces need more bits per pixel to avoid posterisation (banding). The huge ProPhoto space requires 16 bits. While many apps can work in 16 or even 32 bits, most displays are 8-bit. 10-bit colour (also known as 30-bit, since there are three channels) is supported by OS X 10.11 and later, but only Mac Pro graphics cards support 10-bit displays.

Key facts

- A display's colour temperature determines how blue or red it looks, independent of its colour space. 6,500K is standard, but print designers often use a yellower 5,000K
- Your screen's 'canned' profile should be selected in 'System Preferences > Display > Colour'. You can click the Calibrate button to recalibrate by eye, but it's hit and miss.

Jargon buster

Colour numbers are translated into visible intensities on a curve, known as **gamma**. sRGB's gamma is about 2.2, which is now also the default for macOS and Windows. A lower gamma looks brighter. The 'right' level is subjective. ■

Check your iPhone's battery health

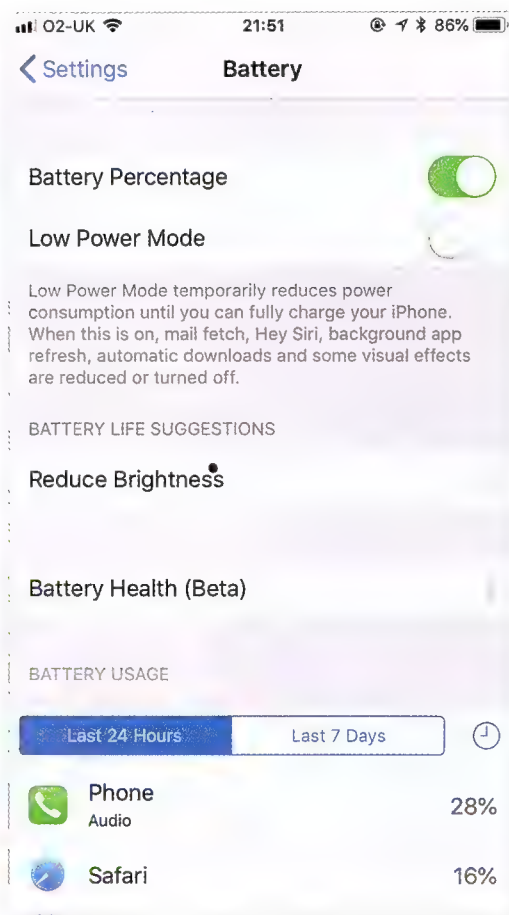
Monitor and control your iPhone's battery health with the new built-in tools within iOS 11.3.

Every time a new iPhone is released, one of the key features critics and buyers look at is the battery life. It's always frustrating to learn that you're on 10% power just after a few hours of use, but now we have a little more information at our disposal thanks to iOS 11.3.

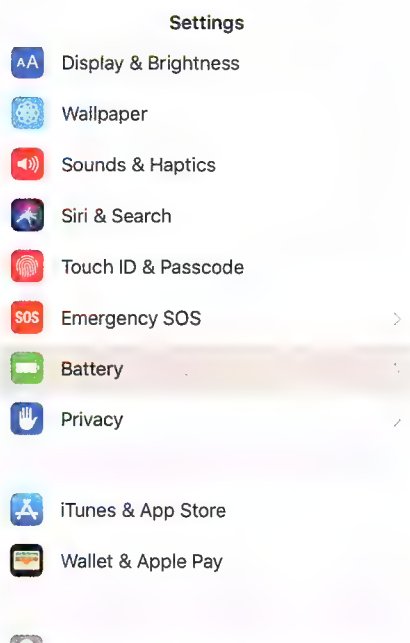
With this update, Apple tells you exactly how healthy your battery is. It also lets you know if performance management is active: this throttles the CPU whenever the battery is unable to provide peak power output to help prevent unexpected shutdowns. You may see longer launch times for apps, lower scrolling frame rates and backlight dimming. The speaker volume may be lowered too. This allows you to continue using your iPhone but it may also point to your device needing a change of battery.

Step by step

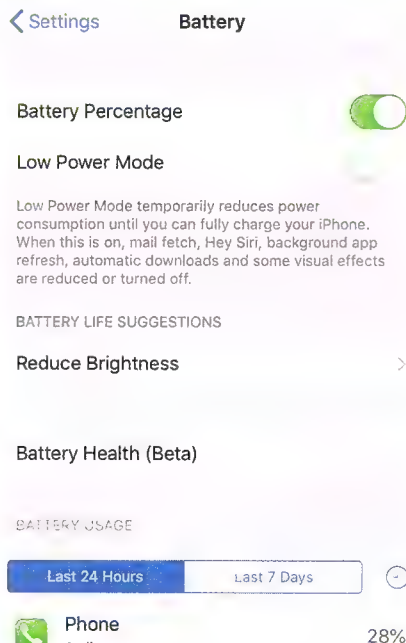
View the status of your battery.



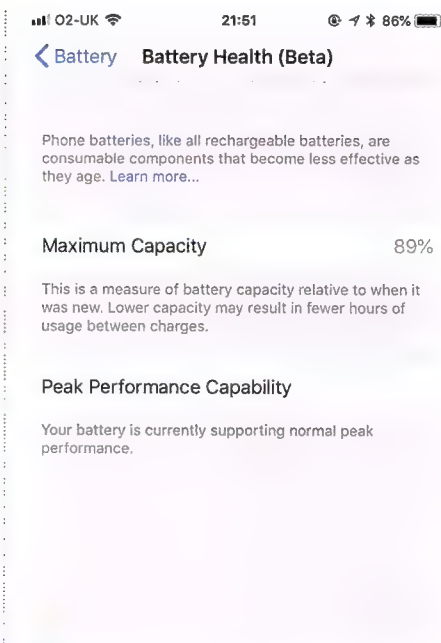
The Battery Health option is new to iOS 11.3, so make sure you've updated before trying to access it.



1 LAUNCH SETTINGS
The Battery Health feature is available in iOS 11.3, so open the Settings app and go to 'General > Software Update' to install. On the main Settings page, tap the option Battery.



2 BATTERY HEALTH (BETA)
You will see a new option called Battery Health (Beta). As the name suggests, the feature is still in its infancy and will likely be improved. Tap this option to access it.



3 SEE MAX CAPACITY
As your iPhone gets older, the battery will lose some of the total capacity that it can hold. You can now see what the current maximum capacity is. New phones will be 100%.

Monitor battery-intensive apps

See which of your apps have been consuming the most power over the last day or week.

1 SELECT A TIMEFRAME

You can reach this screen by selecting 'Settings > Battery'. Scroll down and you can select to see the battery usage by app over the past 24 hours or week, including background activity (when the screen isn't lit).

2 UNDERSTAND BATTERY LIFE

Apple says the amount of charge that can be held by a lithium-ion battery changes as it chemically ages. It means you need to recharge it more often.

3 BATTERY HEALTH

The new Battery Health feature is available in iOS 11.3 for iPhone 6, 6 Plus, 6s, 6s Plus, SE, 7 and 7 Plus. The iPhone 8 and X have hardware upgrades for power management on demand.

4 LOOK FOR PROBLEMS

If you look down the list of apps and one that you hardly use shows a high percentage, then consider deleting it because its power consumption may be far greater than it should be.

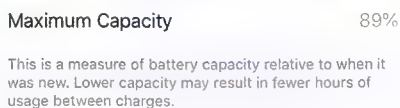
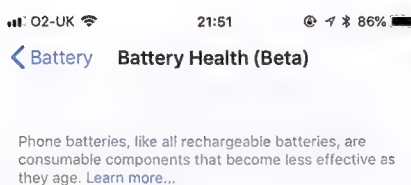
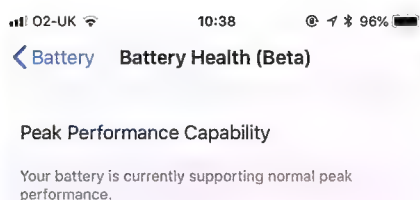


"You can now see what the current maximum capacity of your phone is. New units will be 100%."

Knowledge base

Replace your battery

If your battery maximum capacity is low and you're warned the performance capability is below its peak, contact Apple. Defective batteries are replaced for free within a year but, out-of-warranty, you'll be charged \$39 before 31st December 2018. Visit support.apple.com/en-au/iphone/repair/battery-power for more information.

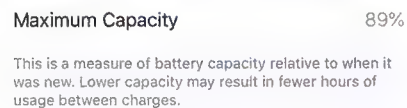
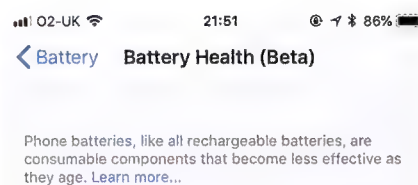


Peak Performance Capability

This iPhone has experienced an unexpected shutdown because the battery was unable to deliver the necessary peak power. Performance management has been applied to help prevent this from happening again. [Disable](#)

5 DISABLE MANAGEMENT

The wording beneath Peak Performance Capability may say the battery can't deliver the necessary peak power. But if you don't want iOS to slow your CPU, then tap Disable.



Peak Performance Capability

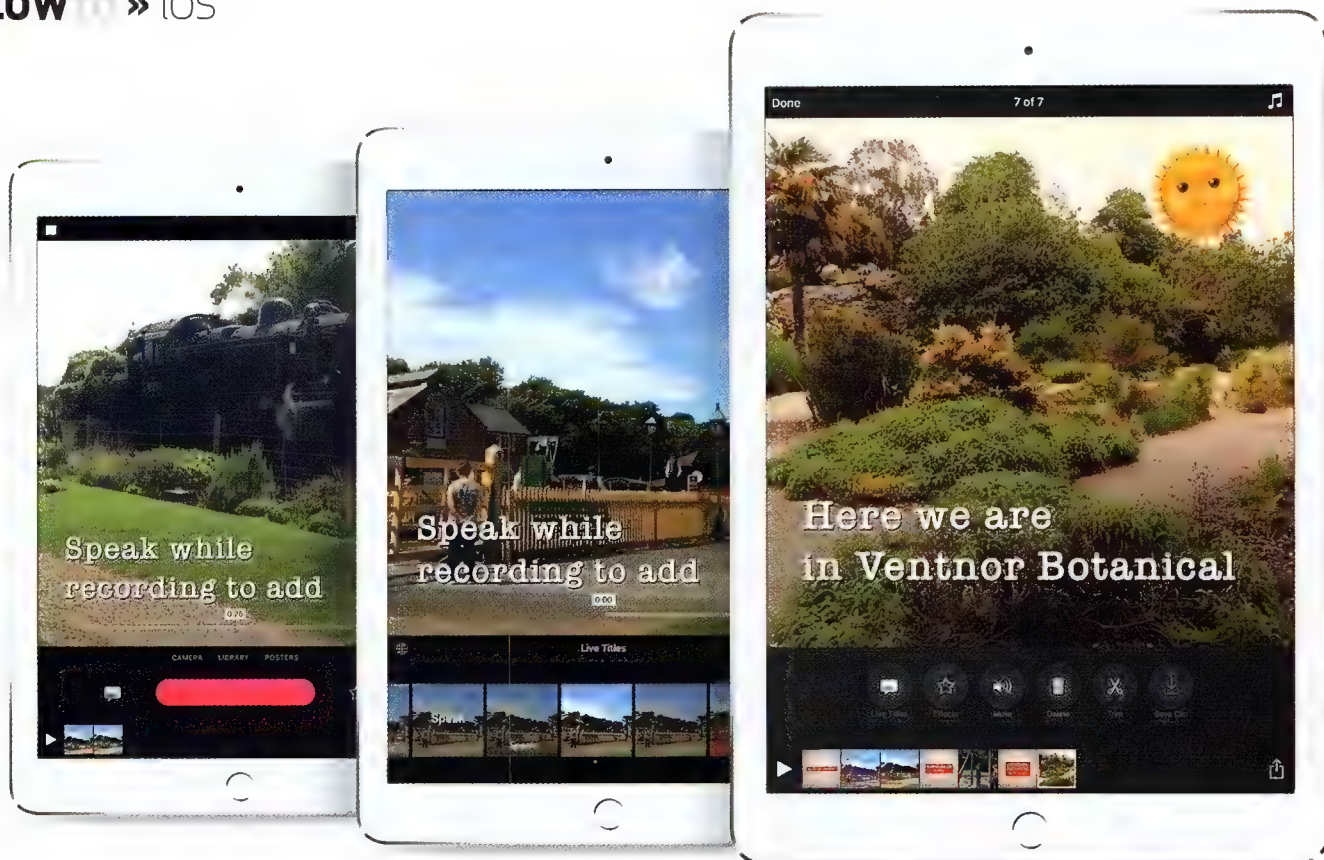
This iPhone has experienced an unexpected shutdown because the battery was unable to deliver the necessary peak power. You have manually disabled performance management protections.

6 ANOTHER SHUTDOWN

When you tap disable, you can't manually re-enable it. Wait for another unexpected shutdown and then performance management will be turned on again. ■

4 CHECK PERFORMANCE

If your battery can't support normal peak performance, Apple slows the device, preventing unexpected shutdowns. View the status under 'Peak Performance Capability'.



Create stunning videos on iPhone with Apple Clips

Nick Peers reveals how to use Apple Clips to create videos that catch the eye.

Clips isn't your everyday video-editing app. Apple designed it with social media in mind – which is obvious from the way it works with square video clips, and images that look best on mobile screens and in web browsers.

Although it can be used on the go – snap a clip, make some adjustments and share it on social media – there are lots of clever and powerful tools hidden away behind the scenes to help you deliver striking video clips complete with a veritable smorgasbord of filters and effects. You can also import clips from your iPad's library – or if you're looking for a way to spruce up an old video sitting on your Mac's hard drive, the quickest way to send it across is via AirDrop.

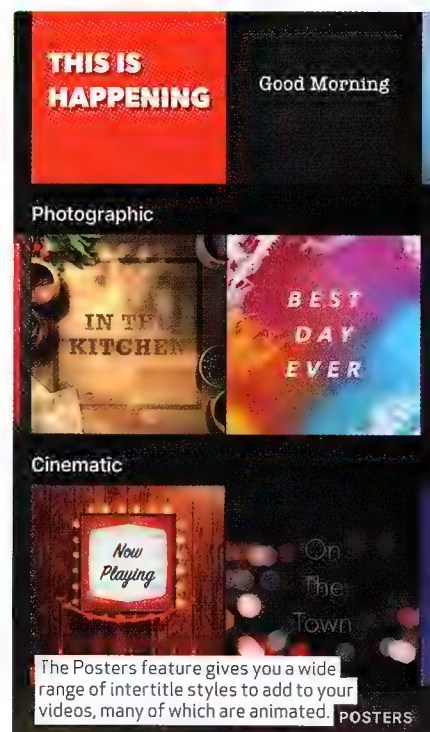
MASTER THE ART OF CLIPS

The basics of Clips are easy to work with, which is why our guide opposite focuses on helping you with some of the app's more advanced features –

particularly how the captioning tool works. This allows you to add on-screen text to your clips at specific points in the movie, simply by speaking the words you wish to appear. Additionally, if you're not happy with a video's original audio, you can replace its captured track with music either from your library or the app's own built-in soundtrack options.

As always with image and video editing, once armed with the knowledge you need, it's tempting to emblazon your work with all manner of effects. However, before diving in, remember the golden rule of all designers and editors: less is almost always more.

Follow this rule for considered effects, and you'll find that your videos will get noticed for all the right reasons.



How to

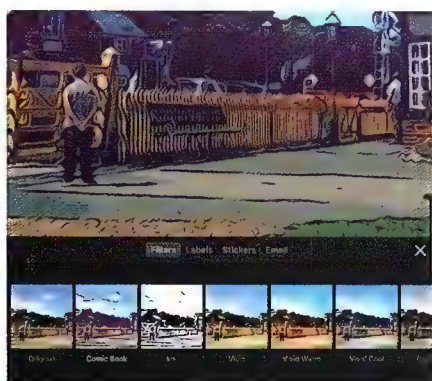
Use Clips' advanced features



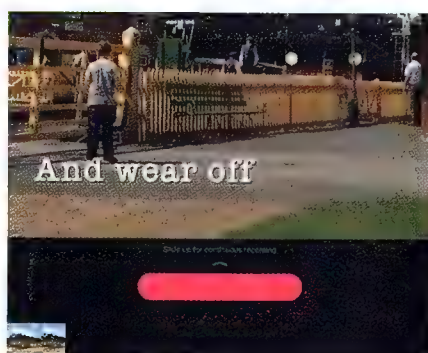
1 CREATE LIVE TITLES
In a project, tap Camera and choose whether to record using the front or rear camera. Tap the speech bubble to pick a look for your captions. Swipe left for more choices. (You can change this later.) Tap one to preview it, then 'X' to apply.



4 FINISH RECORDING
When you're done with recording, tap a clip's thumbnail in the timeline at the bottom to select it. Tap Trim and then drag the arrows at the left and right end of the clip to edit its start and end points, followed by Apply when you've finished.



7 ADD A FILTER
Tap Effects and you'll be shown a selection of filters you can apply to the selected clip — most emphasise the colour or provide black-and-white effects, but two will change its look dramatically: Comic Book and Ink.



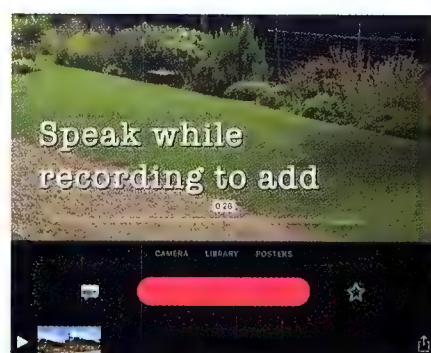
2 SPEAK OVER THE CLIP
Hold a finger on the record button and speak as you record. (Alternatively, swipe upwards from the button to lock in record mode.) Speak clearly and your Live Titles will appear in real time over the preview of what you're recording.



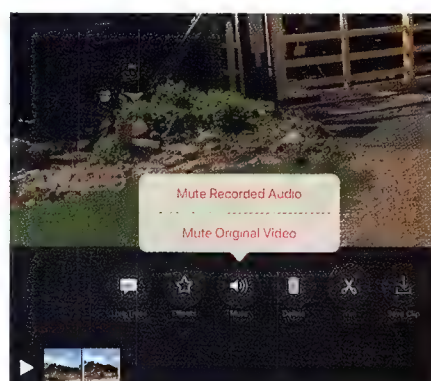
5 CORRECT TEXT
The app may have incorrectly transcribed what you said. Tap a clip in the timeline, then tap Live Titles to view the text — if it's incorrect, tap the words to amend them. Note: you can't alter the text's timing in the clip, just the text itself.



8 LABELS, STICKERS, EMOJIS
While in the Effects tool, tap Labels, Stickers or Emoji to add those elements. Labels and stickers are editable — tap the text to change it. All elements can be moved (by dragging), rotated (twist two fingers) or resized (pinch/spread fingers).



3 CAPTIONING TIPS
Release the button to pause the recording and finish that clip's titles. You can then create a fresh clip right after this point by holding or swiping again. Hold a finger on a clip in the timeline and drag it horizontally to change the order.



6 MUTE THE AUDIO
By default, your speech will be heard when the clip plays — tap Mute if you only want captions. If you're adding Live Titles to a video inserted from your library, you can choose to mute your voice (recorded audio) or the original audio of that clip.



9 ADD TEXT FRAMES
Tap Done to finish working with the selected clip. Tap Posters for a selection of intertitles. Pick a design, then tap the text to edit it. Hold Record for as long as you want the title to be. You can trim or extend its duration later, like in Step 4. ■

Construct smart presentations on Linux

Bobby Moss is here to help you share your knowledge and make those business cases, with LibreOffice's excellent slide-show builder.

Presentation software is hardly the stuff of legends. Unless by legends, you mean legendary dull afternoons spent in a meeting room watching uninspired slide after slide slip into the virtual dustbin of oblivion.

It doesn't have to be this way. Done correctly, slideshows can be a powerful way to share information, draw attention to important messages and ensure people working together have the same understanding so projects can get completed faster. It can also be done in a way that doesn't bore everyone silly!

Now, this is the part where we'd normally say, "And this is where LibreOffice Impress comes in," but the choice of technology in this case is only one part of the equation. The success of a presentation is all about the delivery and how it's received by the audience. Even the best-looking slideshow in the world will fall flat on its face if all the speaker does is read the text off the slides or, worse still, commits the cardinal sin of dumping long essays on each slide and then expects the audience to sit there quietly reading

through it all before they're permitted to see the next one.

In this tutorial, we'll be looking at all the great things LibreOffice Impress can do, but remember as we go through that just because you can do a thing doesn't necessarily mean that you should in every situation. If you distract your audience with garish colours, 'fun' fonts and too many over-the-top animations, you'll have to stand and watch as their very souls are being crushed and a wave of hatred and contempt rolls over you. But if you prioritise the content, keep the design simple and take some time to practise your delivery, then that same audience will be much more engaged, energised and enthusiastic about your ideas. With that in mind, let's crack on and make some outstanding presentations that you can be proud of.

IMPRESSING THE MASSES

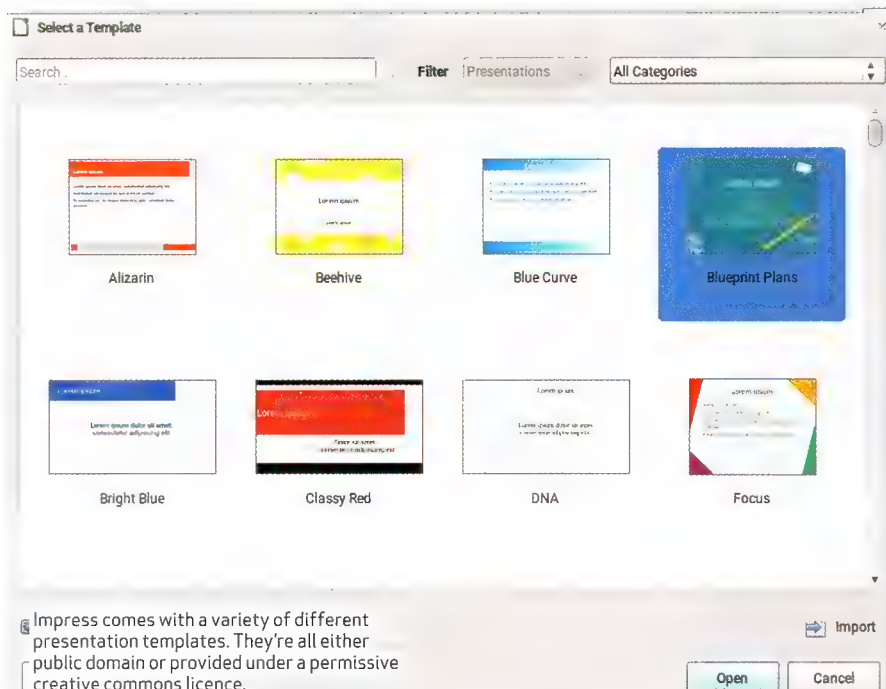
Impress is always included by default with any LibreOffice installation, but if you're using a Ubuntu-based distribution, you may want to add the LibreOffice Fresh PPA to ensure you're working with the latest and greatest

version with all the new templates. Simply follow the instructions at bit.ly/libre-ppa to make this happen. While all the instructions in this tutorial should work with the long-term support version of LibreOffice (5.4.x), we'll be operating on the assumption you're much more interested in utilising the power user features of the newer 6.x releases.

When you first launch Impress, you'll be presented with a window containing a number of templates. We'll come back to this later so you can safely dismiss it for now, and your screen should now be filled with a big white slide with two large text boxes. The one at the top is your title and the one in the middle contains your content. Old hands of PowerPoint will notice that the text section isn't aligned to the top left and it doesn't use bullet points by default. Fortunately, you can change the behaviour of the text box by first clicking and then right-clicking it. Under Align, you can shift the text wherever you need to, and you can add bullet points by clicking inside the text box and then heading to 'Format > Lists > Bulleted List'. The Format menu is also the place where you can change how text appears, alter the spacing between each line and access the right-click options if your laptop trackpad starts becoming frustrating to use.

You'll notice just above the slide there's a selection of different shapes in a toolbar. This exists primarily to help you create diagrams, drawings and flowcharts. There are more comprehensive tools for this in LibreOffice Draw, but you'll find that, for presentation-building, this is more than adequate and a significant time-saver. There's also a shift and pan tool you can trigger by clicking the magnifying glass icon, which is also particularly helpful when you're on the move and don't have access to an external mouse.

When you create a square or an ellipse anywhere on your slide, you'll notice that you can use the miniature squares around it to stretch and distort that shape, and the Line Colour and Fill Colour tools can be utilised to change its appearance as required.



Rotating your shape can be accomplished either from the circular arrow icon on the same toolbar or via the right-click menu, and creating a drop shadow to can be accomplished much the same way (albeit with the tan-coloured box icon).

Once you're satisfied, try creating a second shape. You'll notice if you drag this over your old one, it appears in front of it, but you can move it behind by using 'right-click > Arrange > Send to back'. Much like the commercial alternatives, you'll find that, if you hold down the Shift key, select both shapes, release Shift and then use 'right-click > Group', you can then move both shapes around at the same time.

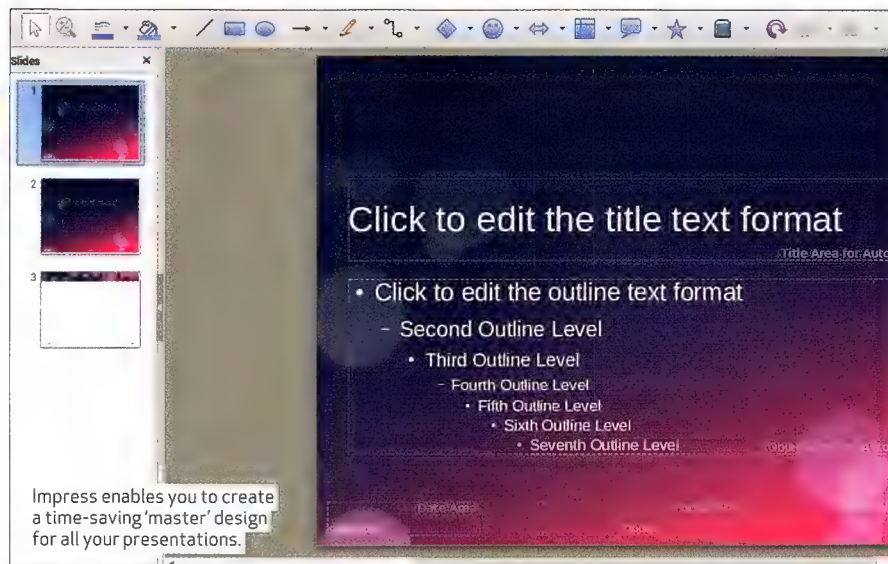
GET CONNECTED

Impress takes this a step further with the Shapes sub-menu that also appears at the same time. This enables you to subtract portions of one shape from another and perform other transformations on them. Finally, to create diagrams with multiple shapes and lines, you can connect them with lines and arrows you've drawn manually or you can use the Connector menu in the toolbar. The latter option creates lines that stick to points on your object, so, as you move it around, the line will move with it automatically. This is particularly helpful when you're creating flow charts for business processes and software programs.

You can also edit the properties of the slide your shapes are on by right-clicking it and selecting 'Properties...'. Here, you can create any kind of background, whether that's a tiled image, a single colour, a gradient between two colours or early '90s-style patterns and hatches. On the Page tab, you can also change the size of your slide to better fit the size and aspect ratio of your projector, smartboard or second monitor.

Few presentations contain just one slide, unless they're being used primarily for digital signage. To create a new slide, you can either use 'Slide > New Slide' or hit 'Ctrl-M'. You'll notice your second slide looks a little different to the first: it'll have a bullet list in its content box and an odd-looking grey icon in the middle. That grey icon enables you to import external audio or video files, and it can also create tables and charts for you.

The table wizard will normally default to having five columns and two rows with a distinctly unattractive choice of greys delineating them. To add a new row, click the bottom one and select 'Row > Insert Rows...'. To delete a row, simply select it from the same menu. Columns function exactly the same way, and you'll also notice that splitting and merging cells



is possible under the Cell option. To change the table colours, you should ensure the entire table is selected and then simply head into Table Properties from the right-click menu. Now you can tweak them as desired by accessing the Font Effects, Borders and Background tabs.

Editing the chart is a little trickier. First, you need to right-click it and select Edit. You should notice that your entire window changes context, with new tools for editing charts. From the right-click menu, you can select the Chart Type if you would prefer a pie chart or line graph. You can also edit the values the graph uses to display data by right-clicking and opening the Data Table. That's also the place where you can change the names of each data type in the legend of your bar chart. Finally, if you want to display the actual values on your chart, you can right-click any data point and

select 'Insert Data Labels', and you can change their numerical format using the 'Format Data Labels...' option that subsequently appears.

CLEVER MASTERS

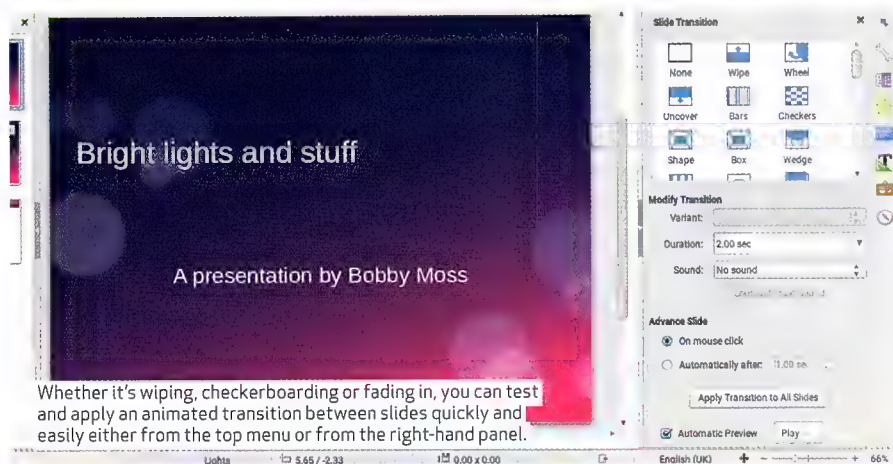
Now we have a handle on the basics, you may be wondering how to make your presentations look more professional. Doing this from scratch is particularly time-consuming, so you're perhaps better off starting with a template. If you create a new LibreOffice Impress document, you'll be prompted again with the template window you saw earlier. This time, try creating one from Classy Red, then create another one using Bright Blue. You'll notice that the starting points for each presentation looks a little different. Bright Blue provides just a single starter slide with the usual format while Classy Red shows off five slides laid out in different ways with

Remote control

If you have an iPhone or Android device, you can remotely control presentations from your smartphone using a mobile app called LibreOffice Impress Remote. Once you've installed the app, launch LibreOffice Impress and head to 'Tools > Options'. Then navigate to 'LibreOffice Impress > General' and then ensure that the 'Enable remote control' box is checked. This enables inbound access from your smartphone and adds useful menu entries you will need later.

Next, you should pair your smartphone with your workstation, and the fully supported way of doing this is by using Bluetooth. If you're using a desktop rather than a laptop, you may need to add an extra USB dongle for this to work. To pair them, enable Bluetooth on both devices, make them visible to each other and then use your distro's settings panel to add your smartphone as a device the system recognises. There's also experimental support for Wi-Fi pairing, which you can enable from 'Tools > Options' and then 'LibreOffice > Advanced'. Note that checking the box for 'Enable experimental features' may lead to strange behaviour elsewhere in your office suite.

Once both devices are paired, you can either connect from the mobile app itself or from inside LibreOffice Impress via 'Slide Show > Impress Remote'.



Printing handouts

To create a generic handout page that contains a minified view of your slideshow, simply head to 'File > Print', and under the General tab, you should see a myriad of options. Under the Print section, there'll be a drop-down menu next to Document, and you should change this from Slides to Handouts. The previewer should change to reflect your choice and you can customise your selection by defining how many slides display per page. Setting it to three slides will usually provide a lined text area next to each one for your audience to take notes. You can also change the order the slides appear in, to better suit your requirements too.

However, this may not provide enough information for you. Many people provide supplementary information in the slide notes and also issue these as handouts for their attendees. Fortunately, Impress supports outputting slides with those notes.

Those of you familiar with commercial alternatives may be wondering where you define your slide notes in the first place, because there's no big white text box just below the slides you're editing to type them into. The place to do this in LibreOffice Impress would be via 'View > Notes', and here, you should see A4-sized pages containing both the slides you've been editing and a space for you to add text content. Once you're satisfied with the notes you have included, simply head to 'File > Print' again and, this time, set the Document drop-down to Notes instead.

custom controls. Clearly, not all templates are equal, but you might be surprised to discover that, when you head to 'View > Master Slide', the only difference between them is that Classy Red has a custom title slide.

So what is a master? In the context of presentations, this is a preset design that all the new slides you create will follow. It's possible to add shapes and background colours, change the fonts and move around your various text boxes.

You can exit the master view either by selecting Normal from the View menu or by clicking the spanner on the right-hand side of the window and selecting 'Close Master View'. You'll notice as you hit 'Ctrl-M' in both templates that they continue to follow the same pattern. To delete any test slides you've made, you should select them in the left-hand panel and then press the Delete key.

In the case of Classy Red, you can change which slide master is applied to any given slide by right-clicking and selecting 'Master Slide...'. You'll notice

that switching to the other one on the title slide removes the red background object and changes all the font colours.

It's also worth mentioning that you can use the slide master to add default slide transitions and text animations to each slide, which comes in

particularly useful if you decide to automate your presentation instead of moving it along with the mouse or direction keys. We'll cover both of those things in just a moment.

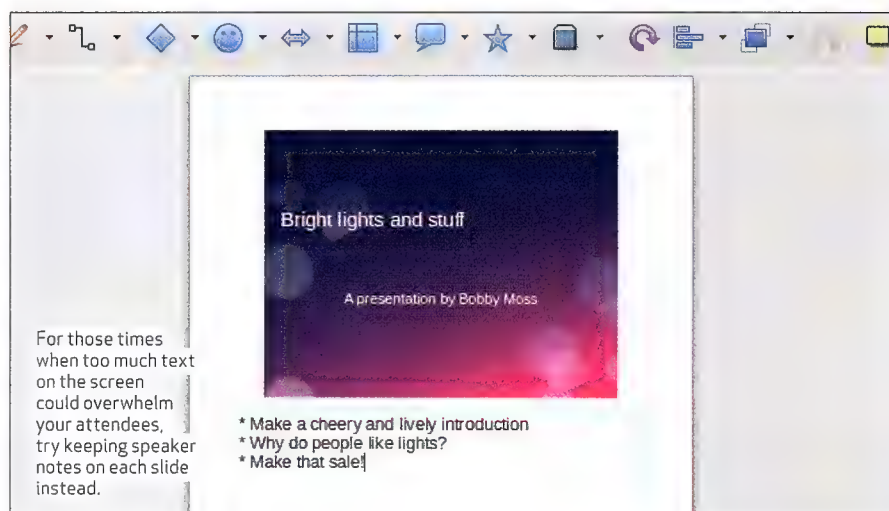
Finally, it's also possible to use the master to change how printed copies of your presentation will be displayed. To see more details about how to do this, check out the Printing handouts box (left), but in order to have some more fine-grained control, the Master Notes view can help you define how Notes pages look when they're printed, while Master Handouts enables you to add extra headers, logos, text boxes and information to that page.

ANIMATED SLIDES

Now you know how to create attractive-looking presentations with flow charts, tables and graphs, you may be wondering how to make your slide transitions more interesting and add animations to objects on your slides. As we mentioned at the start of this article, you may want to be fairly conservative in your approach to both of those things because too much razzle-dazzle can be a little distracting for your audience, but used wisely, they can be a great way of holding people's interest and keeping them engaged with the material that you're presenting.

We'll start by taking a look at creating animated transitions between each slide. You can see the toolbar for this by heading to 'View > Slide Transition' or by clicking the purple icon in the right-hand panel. If you click any of the transitions that appear in that box, you should see it previewed on the same slide you're currently working on. If you just see a black screen, you may need to ensure your graphics driver and monitor settings are configured correctly.

You can change the way the transitions behave under the 'Modify Transition' header. Variants removes



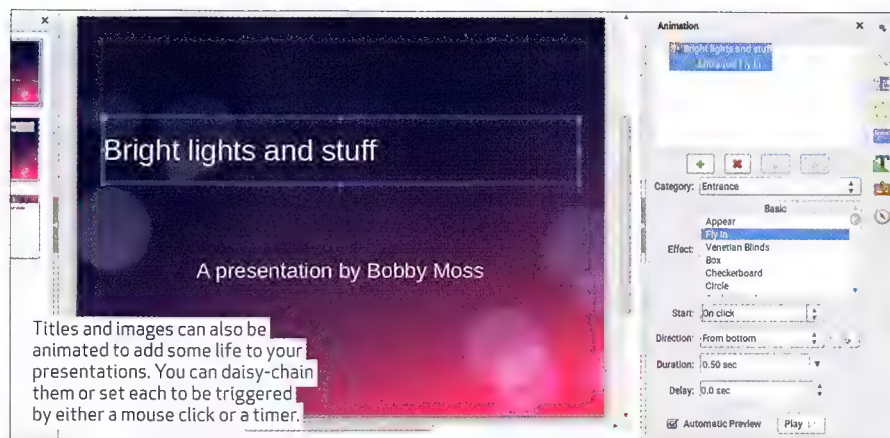
the black background when you're transitioning between two slides. You can speed up or slow down the transition by altering the Duration value. If you want to entertain people, you can also choose a sound effect to accompany the transition, and if you want to annoy them, you can check the box to keep looping it until you reach the slide after the next one!

It's also possible to define what triggers the next slide. By default, it'll always be a mouse click, but you can also set a predetermined time to automate your slide show (see the walkthrough, below). Finally, you can apply the same transition to all your slides either by clicking the 'Apply Transition to All Slides' button or by setting this in the master view instead.

KEEP THINGS MOVING

Next, we can start setting custom animations for individuals pictures, charts and text. You can access that menu either from 'View > Animation' or by clicking the yellow star on the right-hand panel. The button with a plus symbol on it will be greyed out until you select some text on your slide, but once you do so, you can use this to create entrance and exit animations for it. The Automatic Preview box will normally be unchecked by default, but you can check this if you want to test out different transitions before settling on one in particular from the Effect box.

The Category menu also enables you to set a given animation as an emphasis effect that's triggered between your text arriving and leaving. You can also



select 'Motion Path' if you want it to fly all over your slide like a wasp trapped in an empty jam jar. You can also choose to trigger your animation with mouse clicks or link animations together by choosing 'With Previous' or 'After Previous' from the Start drop-down. Annoyingly, the font choice that custom animations use doesn't default to the one you've selected for your slide master, so you'll need to set this for each animation individually.

Finally, you can set timed delays for animations to arrive after you've clicked, which can be useful if you want to trigger several different animations simultaneously while still keeping them in a fixed order.

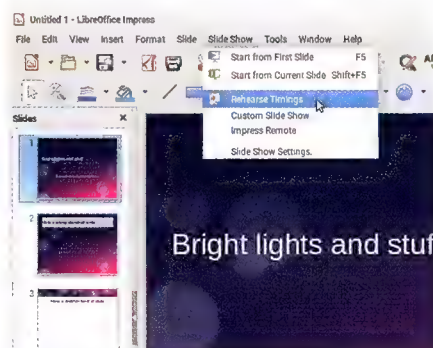
Experienced PowerPoint users may be wondering at this point how they can record narration for automated presentations with animations. Unfortunately, Impress doesn't have an in-built mechanism for this,

but thankfully, there are workarounds if you're willing to use other free software tools.

For example, you could record a sound file in Audacity, import it as a custom sound in the 'Slide Transitions' panel and then trigger it when your first slide starts. The downside of this approach is that, if you have any other sound effects, you'll need to ensure that playing them doesn't end the narration track prematurely.

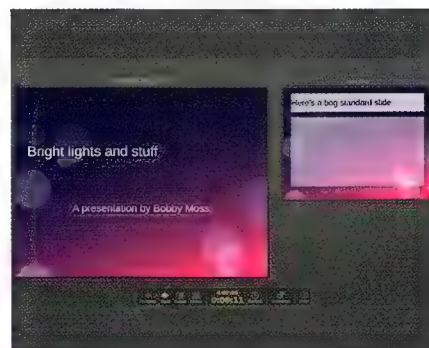
An alternative workaround would be to use screencasting software like Open Broadcasting Studio or Kazam to record your voice and actions as you narrate through the presentation. You can then export this as a video file that you share with your intended audience, but you do risk having to re-record the screencast or make changes in video editors such as Kdenlive or OpenShot if you still need to alter any slides in Impress before it's finally released.

Go down the automation route



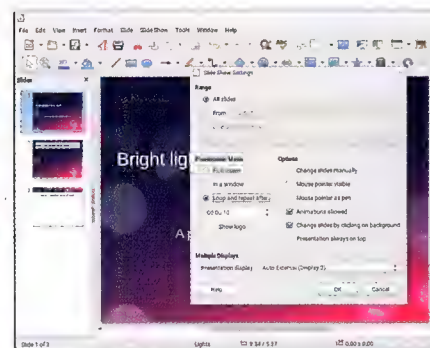
1 START REHEARSALS

Automate your presentation by going to 'Slide Show > Rehearse Timings'. If you're using a dual-monitor setup, you'll see the full screen presentation and the slide assistant with a large timer indicating the current runtime. Rehearsal will begin immediately, so you should ensure that you're ready to begin before triggering it. Exit at any time by pressing Esc.



2 SET YOUR TIMINGS

There are two ways to set timings; One is to click the timer you see in the bottom-left of the active fullscreen slide during rehearsal, and the other is to set your slide's transition to start after a predetermined time interval. You can preserve the latter during rehearsal by simply clicking anywhere else on the slide or using the arrows on the timer screen



3 PRESS PLAY

Once you're happy with your timings, you can decide if your slideshow will simply run once from start to finish, or if you would prefer to keep it going on loop. You can make these changes through 'Slide Shows > Slide Show Settings...' where, among other things, you can also decide which slide your presentation will start on and which device will display it. ■



Build a budget-friendly RGB box

Churning away inside Zak Storey's RGB machine this month is Intel's Core i3-8350K — can it stand up under the spotlight?

THE CONCEPT

There are many reasons why we're not particularly fond of RGB here at APC. We are, perhaps, more than a little bored of it at this point in time — and who wouldn't be? As more and more manufacturers try to cram those tiny LEDs into every different type of computer component, it's easy to see good design go out the window for the sake of more sales.

But perhaps the problem lies less with RGB itself and more with how it's marketed. After all, when the first monitors utilising those tiny light-

emitting diodes came into existence, we didn't have a perpetually scrolling rainbow gradient titillatingly dancing its way across the screen, did we? It's about choice; about displaying what you want. And that's exactly what it should be. Feeling red today? Then switch everything red.

RGB shouldn't be about funky patterns and grotesque combinations of multicoloured atrocities lurking inside your rig, but more about taking the thematic nature of builds that we used to see 10 years ago, and accentuating them with modern design

and contemporary lights, in colours that suit the environment — build yourself that black and red ASUS motherboard, the green flecks of a Gigabyte system or turn the whole thing pink. Surely, that's the point?

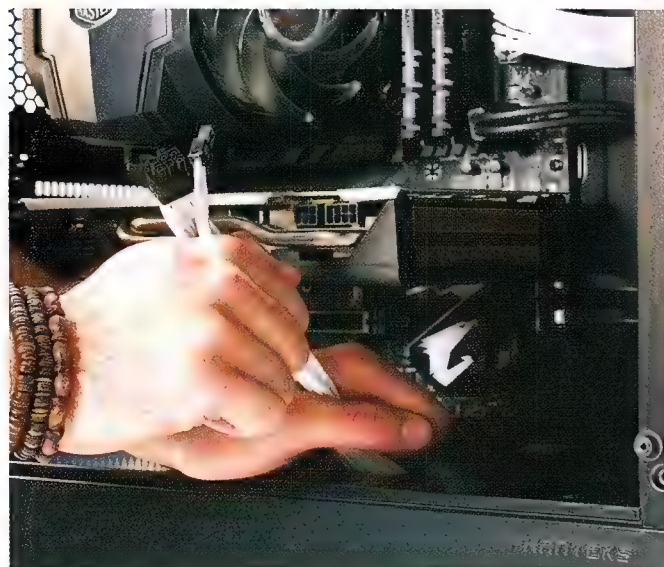
Perhaps we're just a bit too strung up on it. Well, then, let's see what we can do with RGB, instead of just moaning about it. This time around, we're going to take some mid-range RGB components on a journey to see what exactly we can do with the medium that doesn't seem to be disappearing anytime soon.

INTEL UNLOCKED

It's odd to think that, outside of review, we've never had a proper in-system look at Intel's Core i3-8350K. It's a part that's had something of a strange legacy. Indeed, when the first unlocked Core i3 launched in 2017, it was an oddity. Who the hell would want an unlocked dual-core, with Hyper-Threading, that's priced just shy of a base-level quad-core i5? At the time, it seemed ludicrous. Today, on the other hand... Well, with Intel's bumped-up core count, that dual-core i3 is turned into a quad-core one, making it more akin to last gen's i5 than anything else, and weirdly, given the state of gaming today, far more attractive than its predecessor — although, admittedly, you could still nab the Core i5-8400 hex-core part for only \$25 more.

Next up on the list of "pretty things we wanted to use for this build" is Phanteks' latest P350X ATX chassis. It's a super-sweet compact budget tower that, if we're honest, is one hell of an easy sell. As usual with Phanteks, it has managed to transplant the top features that are baked into its more premium offerings into the design of its budget models. Yet it's the aesthetic aspects that really caught our attention: the sharp LED lines in the front panel, with expansive airflow intakes, and the addressable LED strip running alongside the bottom of the PSU cover. It's all there.

Now we're on the topic of custom-lit components, what other illuminated parts did we opt for? Well, there's the Cooler Master MasterAir MA610P CPU air tower, the 16GB of HyperX Predator DDR4 RGB memory, the Gigabyte Ultra Gaming 2.0 motherboard, and the Sapphire Radeon RX 580 8GB Nitro+ with its RGB logo. We've also included a 30cm white LED strip hidden along the front, just to help light up the interior for photography.



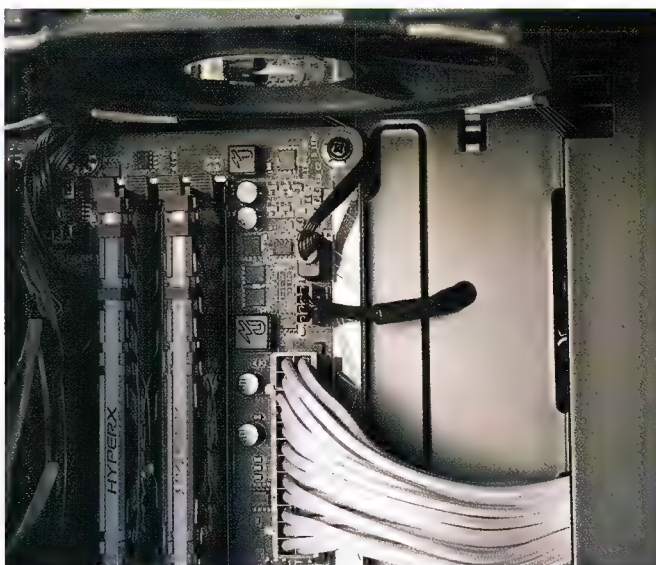
1 CABLE TRAINING PSU

We recently had Alphacool marketing honcho Dave Alcock (and personal modding buddy) drop into our labs to provide some PC building pointers. It's always good to collaborate on a build with a friend, especially one who potentially has more experience than you. Apart from shouting at us for not sleeving our own cables, he did teach us the art of cable training. In short, if you haven't sleeved your own cables to the exact length you need, or have cable combs attached, you can train your cables to lie a certain way. To do this, work out where your cables are going ahead of time, group them together, and bend them the way you need, to plug in to the various sockets, taking the grommet into account. Keep a tight grip, and essentially wring them back and forth, until they fall the way you want. It's not perfect, but it's better than leaving them as they come.

PARTS LIST

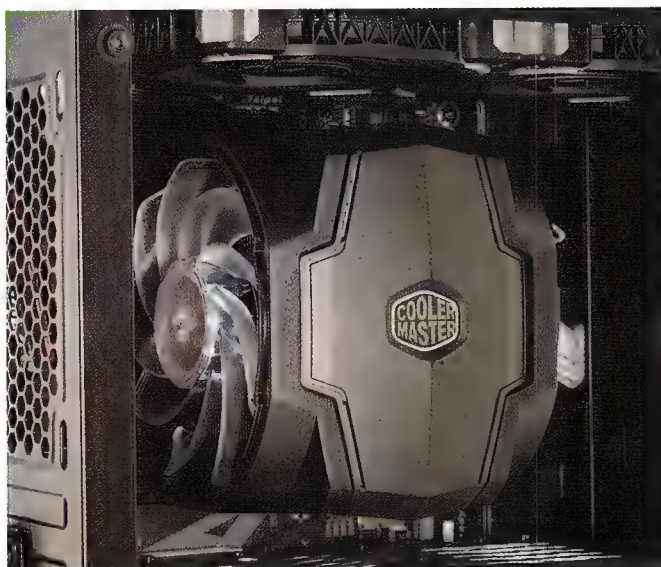
PART		STREET PRICE
CASE	PHANTEKS ECLIPSE P350X	\$99
MOTHERBOARD	GIGABYTE Z370 AORUS ULTRA GAMING 2.0	\$249
CPU	INTEL CORE I3-8350K	\$239
CPU COOLER	COOLER MASTER MASTERAIR MA610P	\$69
GPU	SAPPHIRE RADEON RX 580 8GB NITRO+	\$499
MEMORY	16GB (2X 8GB) HYPERX PREDATOR RGB 2,933MT/S	\$329
PSU	750W CORSAIR RMX WHITE 80+ GOLD	\$220
STORAGE 1	250GB SAMSUNG 750 EVO 2.5-INCH SSD	\$119
STORAGE 2	525GB CRUCIAL MX300 SSD	\$229
OS	WINDOWS 10 HOME 64-BIT	\$149
TOTAL		\$2,201

"RGB shouldn't be about funky patterns and grotesque combinations."



2 THREADING THE NEEDLE

Another pro tip we picked up was with regard to fan connectors — namely, where to thread them through. The front fans in this build were particularly troublesome to route; for the top fan, we ended up routing the cable through the hole in the chassis you can see below. Obviously, there's a big issue with that: the fact that the rectangular PWM fan head won't fit through. In short, you have to detach the plastic fan header. To do this, use a small flat-headed screwdriver, and push down on the clips holding the cables in place on the header. Then carefully pull the cable out — remember which cable plugged into what hole in the header. Thread the cable through the hole, then push the cables back into the plastic header until they click into place, and you're good to go.



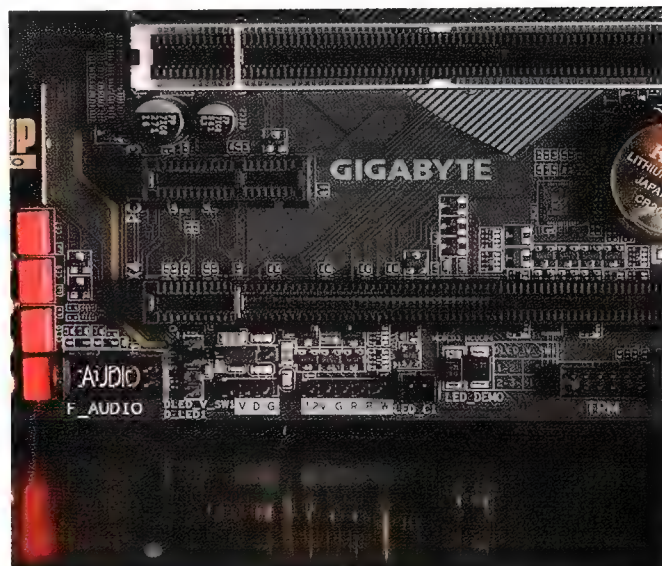
3 CPU TOWER & COOLING

There's no denying that the Cooler Master MasterAir looks deadly. At first glance, it seemed as though the two fans were symmetrical on either side, making us believe that both of them were pushing air inward, and the tower was exhausting that heat upward. Because of that, we installed two exhaust fans in the roof, drawing air out of the chassis, and even considered running another fan in the rear as an intake. On closer inspection, however, although they look symmetrical, the blades on the fan to the rear of the tower are actually inverted, meaning the orientation we have currently draws air in through the front, and pushes it out of the back. Our air-cooled setup still work fines here, but now we'd love to install an additional 120mm in the rear as an exhaust as well.



5 GPU BLOCK

We decided to shake things up for this build, and whip out one of our current favourite AMD cards, the RX 580 Nitro+. Thanks to those ASIC miners coming into production, the price of GPUs has plummeted, both for AMD and Nvidia. One thing we would say is that, if you're looking to make every cent count, we'd drop the Nitro+ Special Edition, and opt for a cheaper RX 580 instead, because you'd probably net yourself a pretty saving. Either that or go for a fairly well-priced GTX 1060 6GB instead. The reason we love the Nitro+ so much, at least for this build, is the sexy backplate on what is technically a mid-range card. It's crisp and clean, and with the white, black and silver colour scheme matching the rest of our build's accents, it really brings the whole system together nicely.



4 RGB CONNECTORS

So in this world of RGB interconnected goodness, where exactly do you plug in all of this well-lit paraphernalia? Well, there are two types of RGB header available: There's the 12V RGBW header, which is the standard analog connector, for simple functioning LED strips; and there's the VDG header, or the addressable header, for when you're plugging in addressable LEDs (which means you can tell each LED in a strip how to operate). Gigabyte's Z370 Ultra Gaming 2.0 has two VDG headers, and two 12V RGBW headers. The 12V RGBW header has five pins on it, and most likely your RGB LED strip will have four pins. To install it, simply plug it into the 12V RGB section, leaving the W pin unconnected. For anything addressable, the VDG header is your gal. Either way, you'll want to make sure you line up the arrow on each connector with the 12V part of the connector, and you'll be ready to go.



6 FU-SION HA!

Let us know if you get that reference. Anyway, back to setup. So you've got your RGB memory installed, your CPU heatsink plugged into your mobo, and your RGB LED strip in there, too. How on Earth do you align this plethora of LEDs? Well, most motherboards come with some form of RGB LED controller software. In Gigabyte's case, that's the Fusion App, found in its App Centre, and downloaded from its website. Simply load it up, and you can control every RGB LED connected to your mobo, DIMMs and all. If you want to control individual segments of the motherboard, head into the advanced header for even more options.



- 1 If only we sleeved our own cables — expect a tutorial covering that exact topic soon!
- 2 Sapphire's Radeon RX 580 graphics card has almost returned to a reasonable price.
- 3 The Phanteks P350X chassis has a multitude of RGB modes for the LED lights.
- 4 Cooler Master's MasterAir touches the side panel, but you can still secure the window.

Purple power

Built in an afternoon, the most difficult part of its construction was figuring out how to install the CPU heatsink (hint: outside the case), and dealing with the fact that it's ever so slightly bigger than what the case can support (it's touching the glass, but everything can be secured down just fine). Aside from that, it was plain sailing. It gave us the chance to put into practice some of the skills we'd learned from our modding friend regarding cable management. A dream build. Two hours, at the end of a fairly friendly working day — what more could we ask for?

With all that spare time, we got to grips with tweaking and tinkering with the system; in particular, overclocking the Core i3. From the get-go, we decided we'd use Intel's XTU desktop software to do some basic overclocking, but after some less-than-stellar results, we ended up diving into the BIOS anyway. With a small bump up in the voltage to 1.4V, we managed a nice 4.6GHz. Not massive, but it did net us scores of 751 in Cinebench R15's multicore, and an incredible 198 in single-core. We did get it running at 4.7GHz on 1.42V, but couldn't achieve any higher than that; 4.8GHz would've been nice, but it just wasn't meant to be.

4.6GHz gave us some solid performance, and acceptable temperatures. It's worth noting that our office is at a constant 21°C ambient temp, so it is a little easier for us to achieve a steady overclock, even in summer. That said, at 4.6GHz, our MasterAir was hitting around 72°C under load with 1.4V, so your mileage may vary. If you do plan on clocking a Core i3-8350K higher, you may very well need a more substantial cooling solution, as Coffee Lake is an exceedingly hot part.

When it comes to graphics, it was quite refreshing to go back to AMD, even temporarily, with the RX 580 8GB. It performed well in our tests — not quite up to scratch compared to our GTX 1060 Labs test PC, but it did well nonetheless. If you have a FreeSync 1080p monitor setup, having a GPU that's capable of driving those kind of numbers at ultra is a fairly sound deal. Again, though, we advise trying to find a cheaper RX 580 than ours.

All in all, it went well. There were no major issues, no first-time boot conundrums and no stress. Combine that with the sleek aesthetic, stunning case and fine lighting provided by the combination of Gigabyte's Fusion software and Sapphire's TRIXX RGB software, and it's a build that we're damn proud of. ■

BENCHMARK RESULTS

	APC LABS TEST PC	THIS SYSTEM
CINEBENCH R15 MULTI (INDEX)	1,152	751 (-35%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	3,400	556 (-84%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	1,720	525 (-69%)
RISE OF THE TOMB RAIDER (AVG FPS)	60	57 (-5%)
TOTAL WAR: WARHAMMER II (AVG FPS)	46	45 (-2%)
TOM CLANCY'S GHOST RECON WILDLANDS (AVG FPS)	39	40 (3%)
3DMARK: FIRE STRIKE (INDEX)	11,101	11,850 (7%)

Our APC Labs Test PC consists of an AMD Ryzen 5 1600, 16GB of Crucial Ballistix Sport LT @ 2,666, an EVGA GeForce GTX 1060 3GB, and a 250GB Samsung 960 Evo M.2 PCIe SSD. All tests were performed at 1080p at the highest graphical profile.

Create a Pi-powered multi-room audio setup

In the first of a two-part series, Nick Peers discovers how to put together an affordable wireless home sound system.

The dream of every audiophile is the ability to listen to music on demand in any room in your home without having to cart CDs, speakers or headphones with you. Manufacturers like Bose and Sonos deliver this dream, but at a price that's prohibitive to many. Our mission, therefore, was to deliver a Sonos-like experience for a fraction of the cost, and thanks to the Raspberry Pi and generosity of Logitech, it's mission accomplished.

Over the next two issues, we're going to reveal how to build your own multi-room audio system around a centralised Pi music server. It'll house your digital music collection and give you access to a range of streaming services such as local, national and international radio, as well as the likes of Spotify. You'll be able to integrate a range of different music players into your wireless home setup, including third-party devices such as AirPlay speakers, enabling you to cannibalise existing equipment to further cut costs. You'll be able to pipe music independently to each player or set up groups of speakers, so that you can listen to the same music in perfect synchronicity throughout your home.

WHAT YOU'LL NEED

Your multi-room audio setup is split into three basic parts: the server, which will deliver the music to any or all of the speakers in your home; a player for each room; and finally controllers, which make it possible



This DesignSpark Quattro case works with any 2.5-inch hard drive — just make sure your cables can stretch around (you may need an extender).

to more easily manage your home sound system remotely. This issue, we'll be focusing on the server and player components.

First, your server. We've chosen Logitech Media Server (LMS), which used to power Logitech's Squeezebox devices, but when the product range was retired, the server software was made open source and now works with a large number of platforms and devices. It's widely supported, frequently updated and capable of just about anything you can throw at it — and if you have Squeezebox hardware gathering dust, you can integrate that into your new setup.

You can run LMS on a wide variety of hardware, but for the purposes of this tutorial, we're focusing on a

Raspberry Pi 2 or later. You can either use the Pi exclusively as your server in conjunction with the PiCorePlayer distro, or install LMS into an existing Raspbian or Raspbian Lite installation if you don't want to tie it down to a single use.

You'll also need to consider where to store your music. If your music library is small enough, you could simply use a large microSD card — 64GB or bigger. You could also connect to a shared folder on your NAS drive (although if you're a QNAP user, you might as well install LMS through the QNAP club repository and offload the job to it — just skip to the 'Set up your server' section).

Alternatively, use an external drive to house your music collection: this could be a USB flash drive, or you could follow our example by pairing your server with an internal 2.5-inch hard drive. We bagged one of the last remaining PiDrives for our gargantuan FLAC music collection, but you could purchase a larger 500GB drive online along with a SATA-to-USB cable quite cheaply. You'll also need a suitable case — we plumped for a DesignSpark case (there are lots of attractive units available from au.rs-online.com).

SET UP YOUR SERVER

If your Pi is going to serve exclusively as your music server (with the option of using it as a player, too), then the simplest thing to do is install the PiCorePlayer (PCP) distro, which



We built our Pi server around a Pi 3 Model B+, 375GB external hard drive and this Quattro case.

comprises a Squeezebox player and supports the ability to install and run LMS. It's tiny and can easily fit on a 4GB card if you're storing your music on a different drive. The simplest way to turn it into a player is to pair it with speakers or hook it up to your home stereo through the 3.5mm analogue jack port with a suitable cable (typically 3.5mm to twin phono).

The step-by-step guide (over the page) reveals how to get PCP installed and running without the need for a monitor or keyboard through your Wi-Fi network. You'll administer both PCP and LMS remotely through your web browser, and you can also `ssh` into the underlying microcore Linux OS (username: tc, password: piCore), although that shouldn't be necessary.

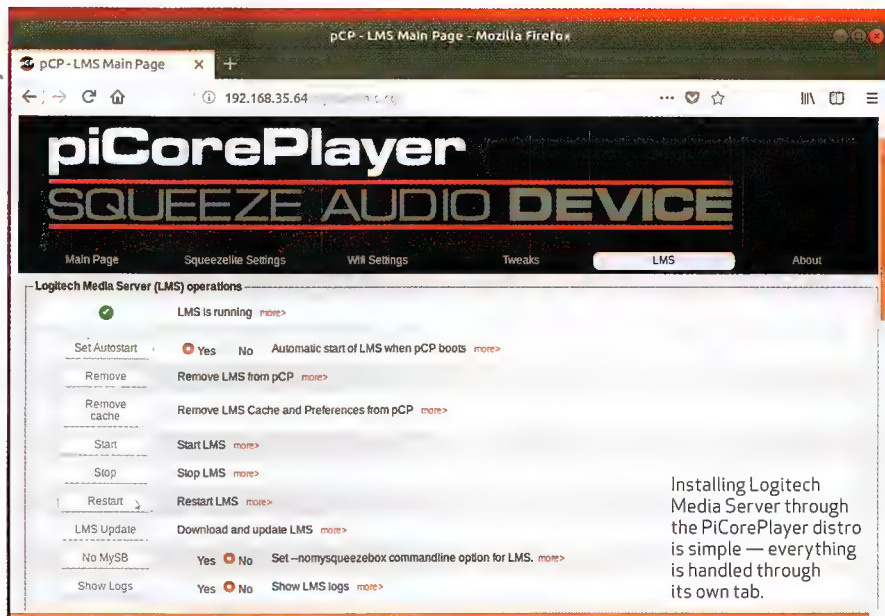
Once you arrive at the initial screen, switch to the Main page tab and select Advanced from the four tabs at the bottom of the window to unlock hidden settings. Now switch to the LMS section and click the Install button to install LMS. You'll be told there's insufficient space on the disk — click OK followed by Resize. Wait while PiCorePlayer reboots and expands the main volume to fill the entire disk. You'll see an 'Unable to connect' page appear — keep refreshing the page until PiCorePlayer reappears, then go back to the LMS tab and try installing it again. Wait while it's downloaded and installed — you'll be kept informed as to its progress — and eventually you'll see '[OK] Backup successful' appear.

Next, scroll down to the Mount USB disk section where you can connect your USB drives to LMS — choose an appropriate mount point (such as data or music) and tick Enabled before clicking 'Set USB Mount' — there's a similar set of options for mounting networked drives automatically, too. Click 'Go Back' and finally click Start to start the server proper. Jump to the 'Prepare your music' section (above right).

INSTALL LMS INTO RASPBIAN LITE

While PiCorePlayer is the simplest route to follow, you may want to add LMS to an existing Raspbian installation. Thankfully, that's a simple task, too — you just need to hunt down the correct commands, which we've done for you, enabling you to install it in Raspbian Stretch Lite:

```
# sudo apt-get update
# sudo apt-get install -y
libsox-fmt-all libflac-dev
libfaad2 libmad0 libio-socket-
ssl-perl
# wget -O
logitechmediaserver_arm.deb
#(wget -q -O - "http://www.
mysqueezebox.com/
update/?version=7.9.1
&revision=1&geturl=1&os=deba
rm")
```



```
# sudo dpkg -i
logitechmediaserver_arm.deb
Once done, the server will be up and
running, ready for you to set up.
```

PREPARE YOUR MUSIC

If you've not yet done so, you need to configure your external drive and transfer your music across to it. The box below reveals how to set up a drive from scratch, ready to receive your music (and automatically mount it in Raspbian Lite). Once done, the simplest way to move your existing library across is to power down the Pi and temporarily connect the drive to the PC housing your music to copy it across manually. We recommend creating a Music or Library folder on your new drive and then replicating the simple 'albumartist/album' folder structure as you copy the music across.

That can get fiddly if you continue to add to your digital music collection — for example, by ripping new CDs via your main PC. Yes, you could set up a shared folder and transfer across on an ad-hoc basis, but for those looking for a simple "set it and forget it" solution, why not install Syncthing on both your server and main PC, then pair the two music folders so changes in one are replicated in the other?

To install Syncthing in Raspbian Lite, initiate the following commands:

```
# curl -s https://syncthing.
net/release-key.txt || sudo
apt-key add
# echo "deb https://apt.
syncthing.net/ syncthing
stable" || sudo tee /etc/apt/
sources.list.d/syncthing.list
# sudo apt-get update &&
sudo apt-get install syncthing
```

Prepare your storage

If you purchased new storage that hasn't yet been formatted, no problem. Install your hardware, boot your Pi, then `ssh` into it from any Terminal. First, we need to identify the drive:

```
# sudo fdisk -l
The following steps assume it's been identified as /dev/sda. If it's not been
formatted, it'll claim to have no partition table — fix that with:
```

```
# sudo fdisk /dev/sda
Press 'O', followed by 'N' and 'P' to create the primary partition. Press '1' and then
allocate it all the space by hitting Enter twice. Finally press 'W' to write the changes
to disk. Next, format the partition — we've picked FAT32 to avoid permissions issues
copying files to the drive later:
```

```
# sudo mkfs.vfat /dev/sda1
```

From here, PiCorePlayer will be able to detect and access the drive; Raspbian Lite users need a couple of extra steps. First, create a folder to mount the drive to — for example, `sudo mkdir /mnt/music`. Finally, enter `sudo /etc/fstab` and add the following before saving and exiting:

```
/dev/sda1 /mnt/music vfat defaults,noatime,nofail 0 2
```

Test your changes with `sudo mount -a`, then `cd /mnt/music` to check that it's mounted.

Visit syncthing.net for a guide to using it.

SET UP THE SERVER

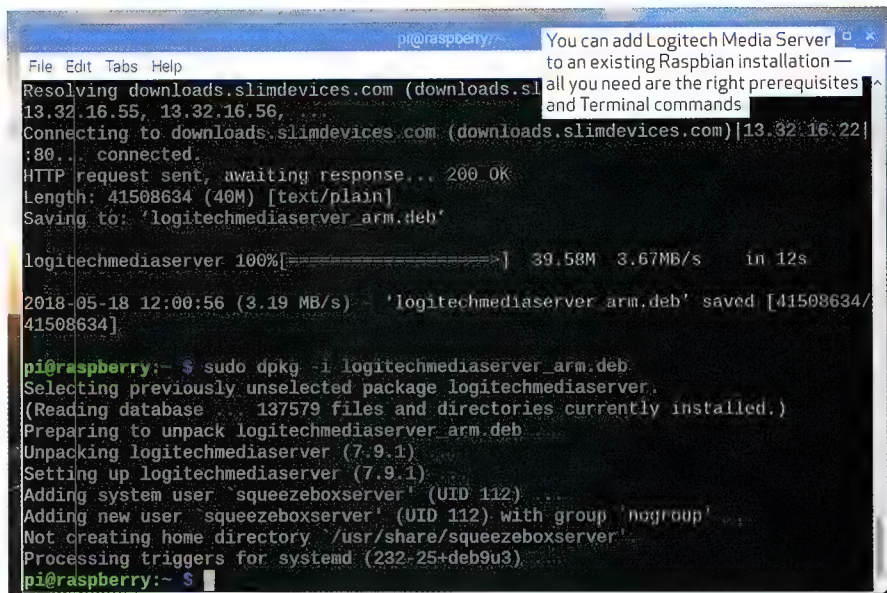
Your OS is in place, LMS is running and your music is copied across and accessible to your Pi. It's time to bring everything together. Type your Pi's IP address into your main PC's web browser, but this time append :9000 on the end – for example 192.168.35.66:9000.

You'll be whisked through a wizard – click Skip to jump past the login screen, then navigate to the folder containing your music (if you've split your library into multiple sub-folders – say, classical and pop – select one for now and you can add more later). Next, you'll be prompted for a playlist folder – we recommend making sure this folder is separate to your main music folder. Click Finish and you'll be whisked to the main screen.

You'll see it's split into two main sections: on the left is the browser, on the right is the current Now Playing list plus playback controls. In the top right-hand corner of the screen, you'll see a drop-down menu that lists all available players – if you installed LMS on PiCorePlayer, you should see it listed. Plug in some speakers into your Pi and it's ready to start playing back your music.

For that to happen, you may need to first scan your library: click Settings and you'll be whisked to a multi-tab configuration screen. Click Rescan next to your media folder under the Basic Settings tab and then switch to the Information tab to watch as the scan progresses. Once it's complete, click Close and browse My Music in the left-hand pane.

You'll see you can browse your library a number of ways. Browse to



a favourite album and roll your mouse over it, clicking the Play button. You'll see the album's tracks appear in the right-hand pane and the music will start to play. You'll also see playback, shuffle, repeat and volume controls along with a power button that can power the player on and off at will.

Roll your mouse over other tracks in the Now Playing list and you'll see play (immediately play this track), X (remove this track from the Now Playing playlist) and M (view track info in the left-hand pane) buttons.

These buttons also appear when browsing your music in the left-hand pane, along with two extras: a heart-shaped button enables you to add the track, album or artist to your favourites, while the + button adds it to the Now Playing list.

Playlists are created from the contents in the Now Playing list – add your items and then click the floppy disk button in

the bottom right-hand corner. Give your playlist a name, click and drag tracks into the desired order and finally click Save. You can edit the playlist from the Playlists menu later, but if you want to listen to new tracks, you'll need to add the playlist to the Now Playing list on the right, then insert your new tracks and click Save again. You'll be asked to overwrite the original — tick the box and click Save a second time to do so.

CONFIGURE POP AS A PLAYER

With your server — and possibly first player — up and running, it's time to take the next step and add more players to take your music into other rooms in your home. LMS is very versatile and works with a range of devices. If you're looking to build a Pi-powered music player, check out Volumio (volumio.org) that we looked at back in issue 452 (see page 96). The hardware costs around US\$90 and provides you with an audiophile-friendly Pi Zero-powered player you can plug into any speaker or home stereo.

You can pair this hardware with PiCorePlayer – skip the section about adding LMS to it and use it exclusively as a player. You'll notice that you have basic playback controls only through the PCP web interface, and if you add multiple PiCorePlayer devices, you can switch between them using the tabs at the top of the screen. By default, all your PCP-powered players will be named PiCorePlayer – change the display name via the Squeezelite Settings page to something more descriptive, such as the room the player resides in.

This tab is also where you'll find settings for changing your audio output – most DACs and soundcards are supported in the audio-optimised build. Other settings are for advanced users, but one of potential interest is LMS IP. If you have multiple LMS servers set up

Enjoying in sync

You're throwing a party and you'd like everyone in the house to hear the same soundtrack. Thankfully, pairing your players together so the same music is heard on multiple speakers at once is child's play in LMS. It's done by organising players into groups, which can be done on ad-hoc basis or as a permanent setting.

The quickest way to sync your players is via the player drop-down menu in the top right-hand corner of the LMS web interface. Use it to select your first player, then click the menu again and choose 'Synchronize...' to select the player you want to sync this one with — the second player's Now Playing list will be selected by default. Now select your third player before choosing Synchronization again and choosing your paired group. Repeat for as many as you need to pair.

Press Play and you should hopefully find they all sync perfectly, but it's likely that there may be some lag with certain devices (we found Chromecast was less reliable than AirPlay for example). You can attempt adjustments via LMS's 'Settings > Player' tab. Select a player from the left-hand drop-down menu and Synchronization from the right to make fine adjustments.

Removing a player from your synced group is simple, too: just switch to it from the main screen, then click the drop-down menu and choose 'Synchronize > No Synchronization' to unpair it.

— say, for different people in your home
— you can instruct your player to set its preferred server here by entering its IP address. Use the Wi-Fi Settings page to change your network settings.

Tweaks is also worth exploring — next issue, we'll reveal how to configure your Pi touchscreen to act as a controller from this dialog. You can also configure your PCP player to act as an AirPlay receiver from here, enabling you to stream music from Apple mobile devices — just set ShairPort-sync to Yes.

ADD MORE PLAYERS

If you're running Volumio on your audiophile-friendly Pi device, there's no need to go through the rigmarole of replacing it with PiCorePlayer — simply go to 'Settings > Plugins' and install the Squeezelite Player plugin via 'Settings > Plugins'. Once done, your Volumio device will show up as a player like any other.

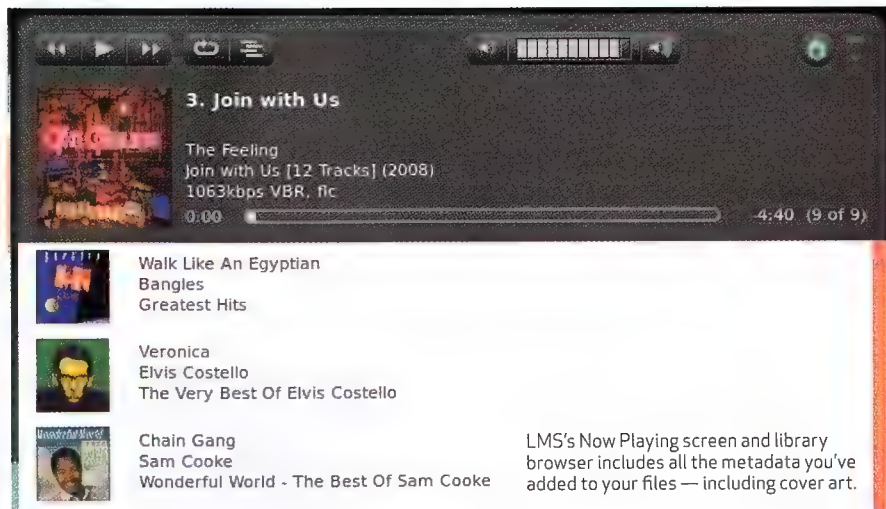
Squeezelite software players are also available for a wide range of devices — note these are headless and so must be controlled through your server's web interface for now. In the case of your Linux PC:

```
# sudo apt-get install
squeezelite
# squeezelite -z
```

Visit ralph-irving.github.io/squeezelite.html for more usage instructions if you need them.

You'll also find paid-for apps for Android such as SqueezePlayer, while Pi users running Raspbian Lite can follow a tutorial at bit.ly/raspbian-squeezelite.

It's also possible to extend LMS support to include AirPlay-powered speakers, Chromecast devices and DLNA media clients via plugins.



LMS's Now Playing screen and library browser includes all the metadata you've added to your files — including cover art.

DLNA support is already installed, but disabled — open the LMS web interface and head to 'Settings > Plugin' tab. Tick 'UPnP/DLNA Media Interface' under 'Inactive plugins' and click Apply to make the server visible to DLNA clients.

AirPlay and Chromecast support works identically: scroll down to '3rd party plugins', tick 'AirPlay bridge' and/or 'Chromecast bridge' and click Apply. When prompted, restart the server and click OK. Refresh the page and you'll see either or both bridges are enabled.

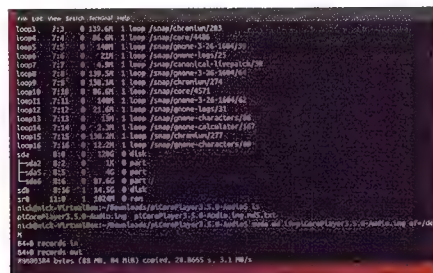
To get them working, click Settings in turn — first, select the correct binary version, which is the 'static' one. We advise ticking 'Use LMS' network interface' to ensure all devices connect. That should be sufficient — tick 'Not Running' followed by Apply. Then refresh the page — when you navigate back to settings you should

see it's now running and any AirPlay (and/or Chromecast) devices switched on should be detected and listed. You'll now be able to select them as players like any other.

COMING SOON

You now have your basic multi-room audio system in place. You have a centralised server and at least one player, with the option of adding more from a variety of sources and at significantly less cost than investing in a branded solution. As things stand, playback requires you to log on to your server's web interface, but next issue, we'll look at how you can introduce a variety of different controllers to give you more convenient access to your music libraries. We'll also take a closer look at some of the more advanced and hidden uses for your new wireless home music system — you've only just begun to explore what it's capable of!

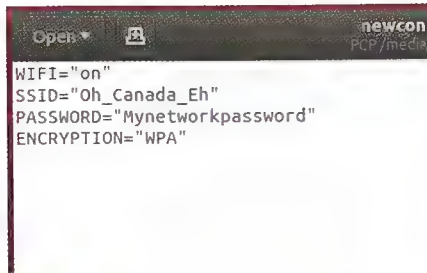
Install PiCorePlayer on your Pi



1 PREPARE THE MICROSD CARD

Download the latest audio-optimised PiCorePlayer image from sites.google.com/site/picoreplayer/home/download. Extract the IMG file, insert your microSD card and open Terminal. Go to the IMG file's directory and use `lsblk` to spot your microSD card. Type the following (if your card is identified as /dev/sdb):

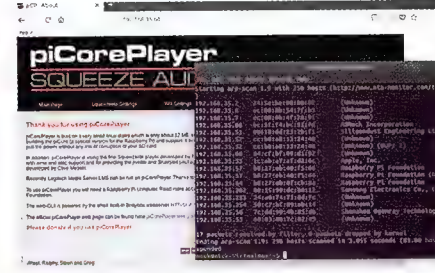
```
# sudo dd
if=piCorePlayer3.5.0-Audio.img
of=/dev/sdb bs=1M
```



2 ADDING WIRELESS INFO

Once the image has been written, close Terminal and open Text Editor. Type these four lines, substituting your network information where appropriate. Once done, save the file to the root of the PCP volume as `newconf.cfg`.

```
WIFI="on"
SSID="yourSSID"
PASSWORD="yourPASSWORD"
ENCRYPTION="WPA"
```



3 BOOT AND CONNECT

Eject the SD card and transfer it across to your Pi. Power on and wait a few minutes before opening Terminal on your PC and installing an IP scanner:

```
sudo apt-get install arp-scan
```

Use `sudo arp-scan -l` to locate your new Pi's IP address, then type that into your web browser to accessing the PiCorePlayer configuration screen and start setting things up. ■

Make your own Chromecast Audio

Never throw away a good Android phone. Darren Yates explains how to repurpose it into a cheap Chromecast Audio clone.

In last month's Android Masterclass, we looked at how you can take your Android audio to the next level, and as a result of renewed focus by almost every vendor from Google down, the beats you listen to are steadily improving. Yet, while Bluetooth audio is receiving plenty of new love, thanks to Qualcomm and Sony, you might still find it easier to stream your audio via Wi-Fi and devices like Google's Chromecast Audio dongle. However, if you have an old Android phone holding up a shelf, here's a chance to dust it off and make your own Chromecast Audio clone. And no, you won't need root-access, either.

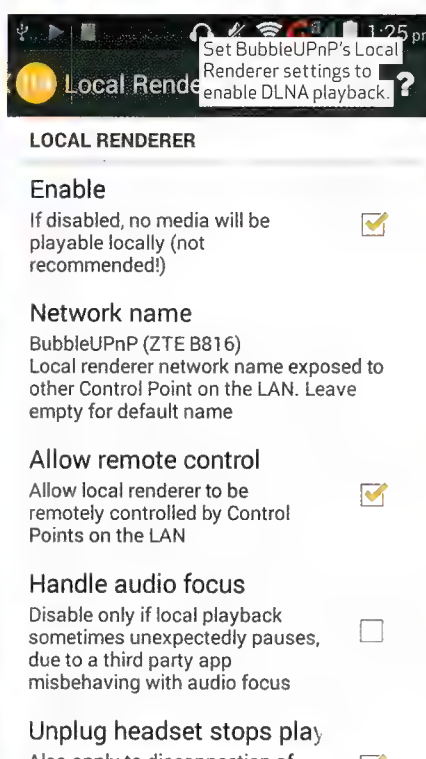
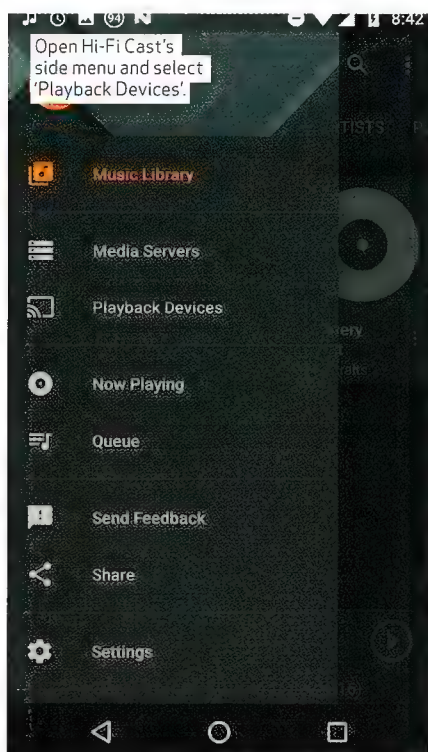
BUDGET BUYS

I have a thing for budget prepaid Android phones, but to limit myself, the rule is I only buy one if it's cheaper than the last budget phone I bought. This started with an Alcatel Pixi 3 4.5 for \$34.50, then a prepaid Boost Indy (ZTE B816) for just \$19. They're not world-beaters, sure, but to me,



This old ZTE B816 dual-core phone cost \$19 and came with Android 4.4.

This Alcatel Pixi 3 4.5 phone handled BubbleUPnP without issue.

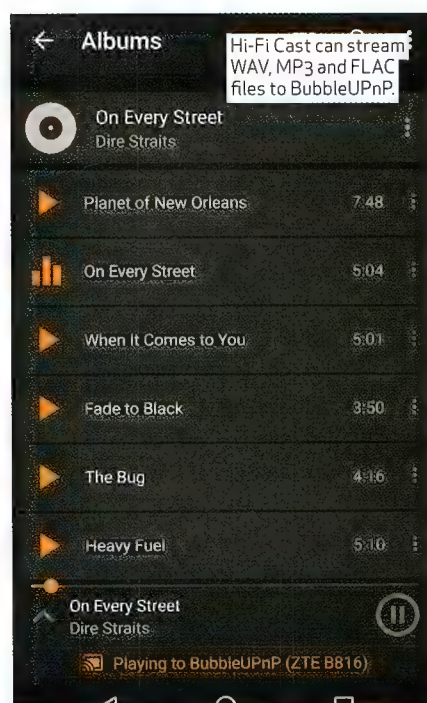
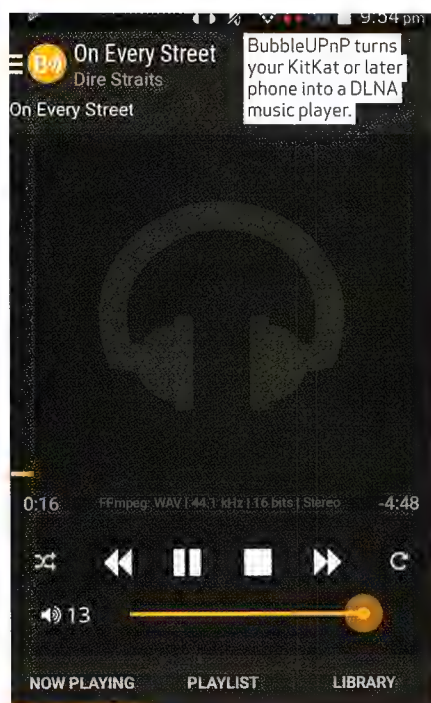


they're not phones – they're multi-core battery-powered touch-screen computers for basically the price of an evening meal.

That \$34.50 phone came with Lollipop/Android 5.1 and quad-core ARM Cortex-A53 CPU, which gives it plenty of Android API (application programming interface) value and loads of horsepower to work with. In other words, check your drawers – you'll likely have an Android phone lying around that could be as good, if not better. As long as your device has at least Android 4.4, you've got the makings of your own Wi-Fi player.

HARDWARE SETUP

The method we're using this month is to stream music files stored on your everyday phone over your home Wi-Fi network to your 'Chromecast Audio clone' phone. Plug a set of computer speakers or your home Hi-Fi system into your clone phone's headphone socket and you're good to go. As simple as it sounds, this method has a few benefits. First, it doesn't assume you



have a home media server (although it can be made to work with one if available). Second, it doesn't rely on your clone phone having any worthwhile storage – even if it's only 4GB of internal flash, its fine (that's because your clone phone is simply playing the audio data streaming to it from your everyday phone). Third, there's no Bluetooth involved – that means no low-end sub-band coding (SBC) compression. Instead, our method will play not only MP3 files, but uncompressed WAV and lossless-compression FLAC audio as well.

SOFTWARE SETUP

To glue this all together, you'll need two apps from Google Play, and neither of them requires root access. On your everyday phone, install 'Hi-Fi Cast + DLNA' (we'll just call it 'Hi-Fi Cast' from now on). This is a nice clean audio player that can also stream audio wirelessly to DLNA music playback devices or 'renderers'. If you have a Hi-Fi DLNA player from the likes of Yamaha, Denon or Onkyo, the Hi-Fi Cast app should locate it and be able to stream your music straight to it. If you don't have one of these, that's where Google's Chromecast Audio dongle would normally slot in, but instead, it's where we're plugging in your old Android phone.

Speaking of which, grab your old phone, head to Google Play and install 'BubbleUPnP for DLNA/Chromecast'. This app is similar to Hi-Fi Cast, except it also has a built-in DLNA stream player or renderer – it's this feature that turns your phone into a Wi-Fi player.

SETTING UP YOUR CLONE PHONE

Once you've installed BubbleUPnP, launch it – and that's about it. You'll obviously have to boot your clone phone onto your home Wi-Fi network, adjust the audio output level and ensure your speaker system is set up, ready to go. But otherwise, BubbleUPnP will do the rest. One thing, though – the free version only gives you 30 minutes of DLNA rendering love, so test it out, if it works for you, buy the licence for about \$7 or so. The only other thing you may need to do is just open up the BubbleUPnP Settings menu, select 'Local Renderer' and see that the 'Allow remote control' checkbox is ticked. It should be but check it anyway.

SETTING UP YOUR EVERYDAY PHONE

Now you go back to your everyday phone and launch 'Hi-Fi Cast'. Allow the app access to your local files, then, when the main app window appears, tap the hamburger side-menu button on the top-left of the screen and choose 'Playback Devices'. If your clone phone is powered up and BubbleUPnP is sitting, ready and waiting, you should see the BubbleUPnP entry appear. Tap the entry and you're done. Now, just go back a screen and move through your songs on Hi-Fi Cast's album list, select a song to play and the dulcet tones should begin emanating from your sound system in a few seconds.

Once BubbleUPnP is running, you can turn off the clone phone screen and it should be fine. And as a nice touch, go into BubbleUPnP's Settings menu to Control, tap 'Start on boot'

and the app will automatically launch as soon as your clone phone boots.

TROUBLESHOOTING

Provided your clone phone has at least KitKat/Android 4.4, technically you should be able to use a device with just a dual-core Cortex-A7 CPU. While measuring CPU usage with CPU-Z (also on Google Play) on our test dual-core ZTE B816, the CPU regularly switched off one of its two cores and coasted along at around 10% usage. However, every now and then, we'd get occasional audio dropouts – BubbleUPnP suggests the solution is to switch off the 'Handle audio focus' setting just below the 'Allow remote control' checkbox. It didn't help us. However, the \$34.50 Alcatel Pixi 3 4.5 phone with its quad-core Cortex-A53 CPU running as the clone phone didn't miss a beat. Try turning off any auto-sync feature in Android if you're getting glitches on a dual-core phone.

RECLAIM AND REUSE

It might surprise you but the hardware inside many of your favourite home tech gadgets is pretty similar – an ARM phone-grade Cortex-A class processor, some RAM, some flash storage, a bit of network access along with its purpose-built input and output features. Rather than contributing your old devices to land-fill, gain skills by learning how to reuse your tech. It might not always be easy, sometimes it might not even be possible, but chances are your old tech can still do more than you might expect. ■

Turn a Cortex-M3 board into a digital audio recorder

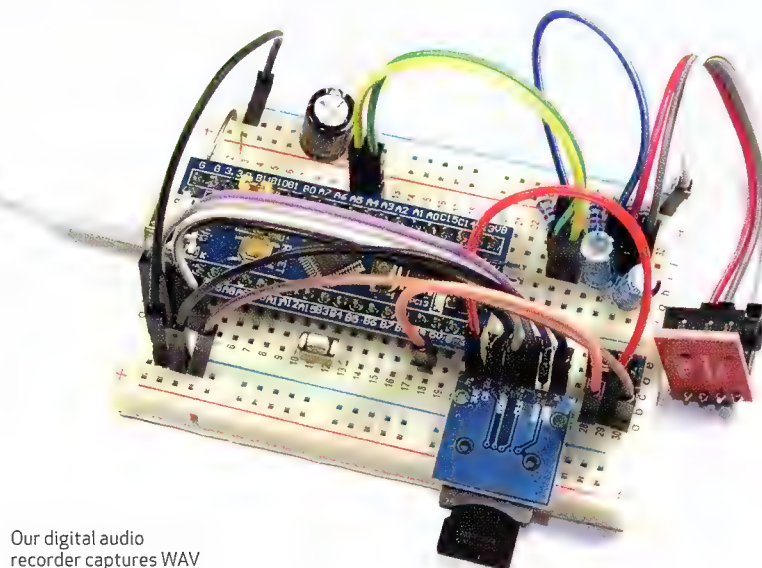
It has no SD card port and isn't designed for audio recording. Darren Yates shows how to turn this STM32F103 board into a digital audio recorder using the Arduino IDE.

Digital audio recording has always been one of the top two most popular topics we've covered in our Arduino masterclass (the other being robots). The problem with most microcontroller unit (MCU) boards, though, is that they're not designed for digital audio. Previously, we've cajoled older 8-bit Arduino boards such as the Nano, Uno and Mega2560 into recording audio, but this month, we're taking on our first ARM Cortex-M3 MCU version using the popular mini STM32F103 board selling on eBay for under \$5.

CORTEX-A VS CORTEX-M

The tiny Nano-style board we're using for this project features ST Microelectronics' STM32F103C8T6 MCU based on ARM's popular 32-bit Cortex-M3 processor core. Android phones use Cortex-A series CPUs designed to run a full-blown operating system, but the Cortex-M series are for 'embedded' applications where there's usually only one job to do – running your source code. The STM32F103C8T6 MCU clocks along at 72MHz, has 20KB of RAM and 64KB of flash – not earth-shattering, but plenty when there's no OS to weigh everything down.

Two key things about this project – first, you'll need soldering skills.



Our digital audio recorder captures WAV files to microSD card.

Don't have them? Get them, or rope in a knowledgeable mate. Second, as this board is not standard Arduino-issue, we need to go next-level and program it via an external link module. We'll show you how, but it's not as easy as plugging in a USB cable, so be warned.

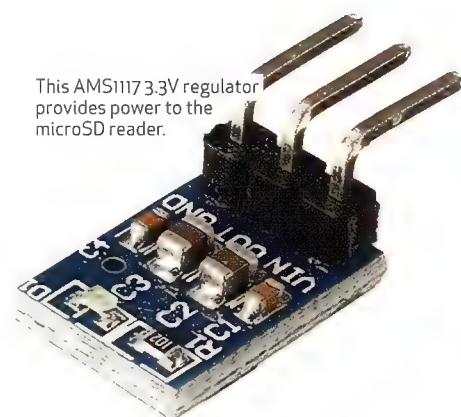
FEATURE-TWEAKING

With only 64KB of flash storage, we'll also need external storage to store our audio, but before that, the STM32F103 has no audio inputs or a Secure Digital Input/Output (SDIO) port for SD card

storage. So we feature-tweak. The chip does have two 12-bit analog-to-digital converters (ADCs) and two Serial Peripheral Interface (SPI) ports – with some coding tricks, we can knock them into shape.

ANALOG-TO-DIGITAL CONVERSION

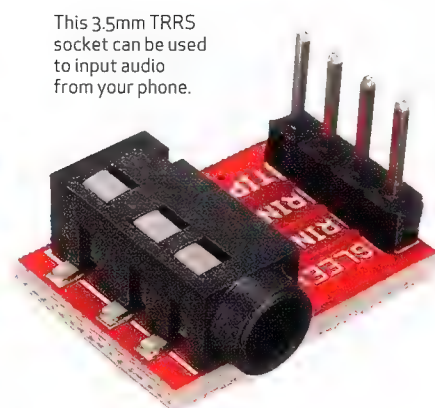
The two ADCs in the STM32F103 are fully-programmable and have a top speed of one million samples per second (1Msps), but for audio CD-standard recording, we need 44,100 samples of 16-bit depth per second



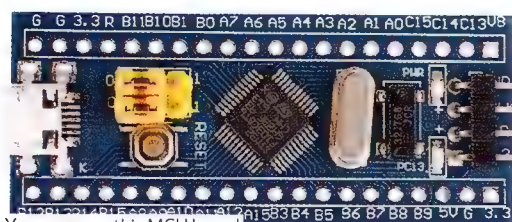
This AMS1117 3.3V regulator provides power to the microSD reader.



This tiny microSD card reader is designed for 3.3V MCUs like the STM32.

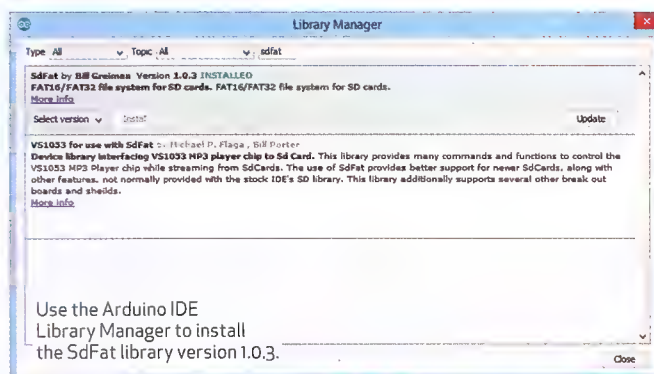
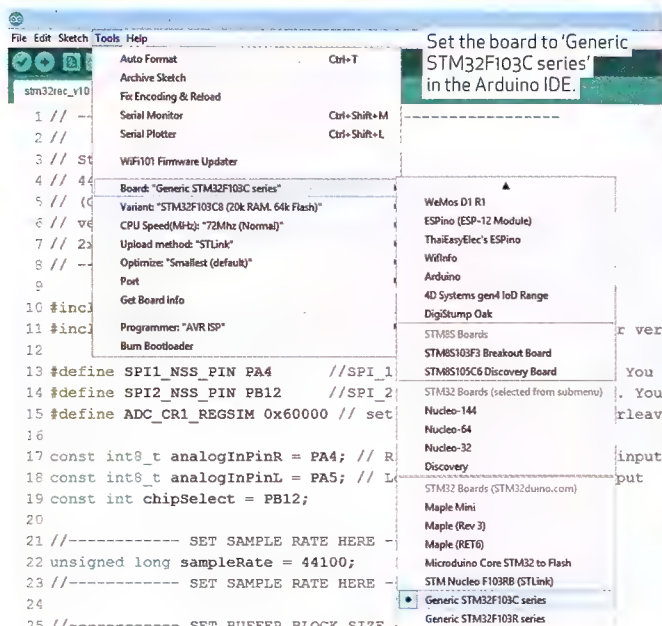
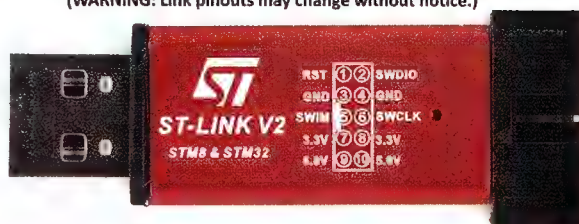


This 3.5mm TRRS socket can be used to input audio from your phone.



You program this MCU board via a \$5 ST-Link V2 USB module.

(WARNING: Link pinouts may change without notice.)



"This board is not standard Arduino-issue, we need to go next-level and program it."

or '44.1kHz/16-bit' sampling. Here's what we do. First, we set the two ADCs to sample simultaneously – one grabs the left-channel, the other the right. Next, we use one of the chip's counters or 'timers' to trigger an interrupt as close to 44,100 times per second as we can. This is done by dividing the 72MHz CPU clock by a counter number that gives us the nearest interrupt trigger rate. That number is '1,632'. Divide 72,000,000 by 1,632 and you get 44,117, which is less than 0.03% off 44,100. We use this to trigger the ADCs into grabbing an audio sample – but from where?

ANALOG INPUTS

The MCU chip has 10 analog inputs – we need just two and we're using inputs PA4 and PA5. They're not specifically designed for audio, but we can make them accept audio by setting the DC voltage level of each input separately to half the 3.3VDC supply rail using two sets of two 10kohm/1% resistors as voltage dividers. The junction connects to the analog input pin and sets the voltage to within 1% of half-way (1.65VDC). We then add a DC-blocking capacitor to this junction and feed in the audio to the other end of the capacitor. The audio is overlaid onto the 1.65VDC voltage so that the

full waveform is captured within the 0 to 3.3VDC range of the ADCs. The limitation with this method, however, is that you must feed in 'line-level' audio, anywhere up to 1.2Vrms. You cannot direct-connect a mic – microphones typically generate just 0.01Vrms, which simply won't register (a 40dB-gain preamp will fix this, though).

GETTING 16 BITS FROM 12

This still leaves us with the problem of the ADCs producing 12-bit samples, rather than the 16 required by CD-standard audio. However, there is an easy fix – we take each 12-bit sample and 'bit-shift' it four places to the left, turning 12-bit samples into a 16-bit number. For example, the sample '110100111001' becomes '1101001110010000'. The four least significant digits will always be zero and really, it's a bit like using the digital zoom on your camera – we're just making the samples larger. However, in this case, it's a necessary step to force the samples into 16-bit compliancy.

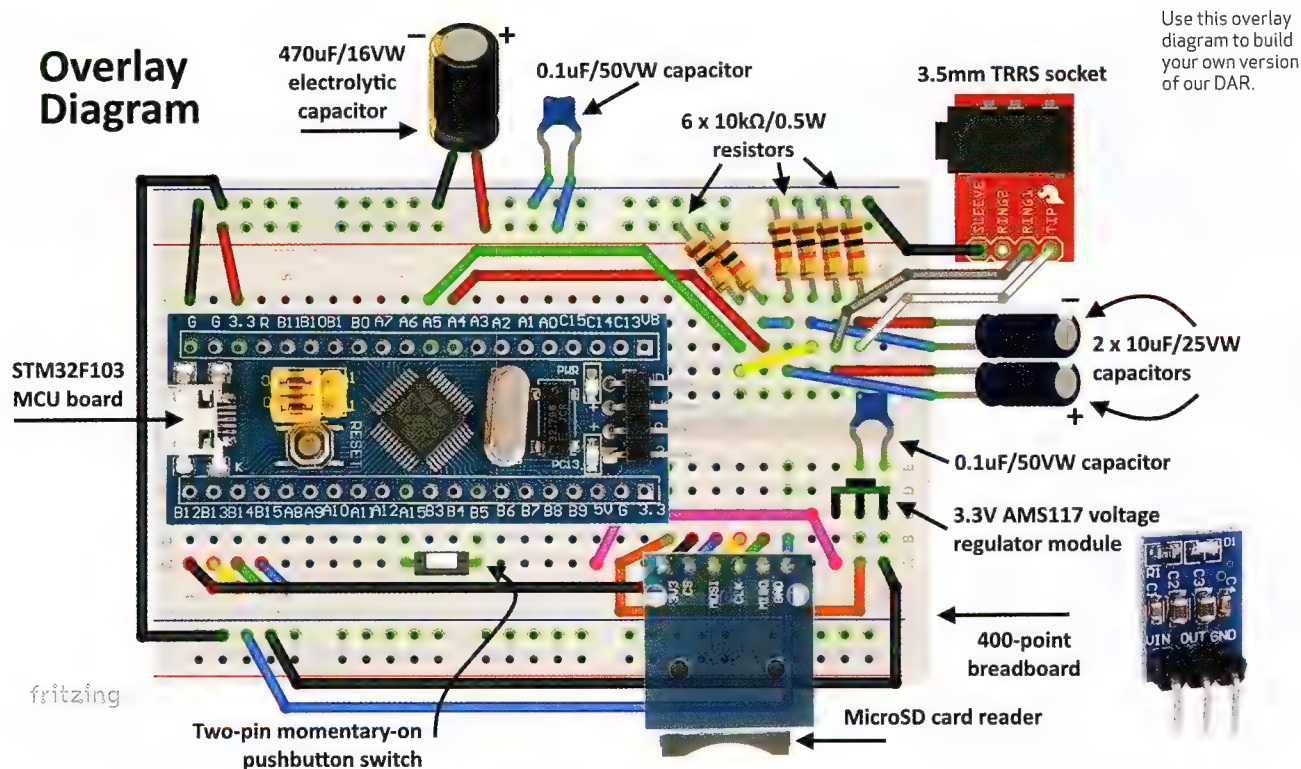
SERIAL PERIPHERAL INTERFACE

The MCU chip may not have a dedicated SDIO port, but SD cards also support the simpler SPI standard and

we use this here with our tiny microSD card reader module. However, in order to power the module and minimise digital noise on the audio, we add in an external voltage regulator. The STM32F103 takes power via USB, but at 5VDC, this voltage is too high for both the chip and the microSD, which both work on 3.3VDC. The MCU board has a small 3.3VDC voltage regulator on board, however, it's quite tiny, so to lighten the load, we use an external 3.3VDC regulator that takes power from the board's 5VDC pin and creates a separate 3.3VDC voltage rail to power the card module.

JUGGLING THE TASKS

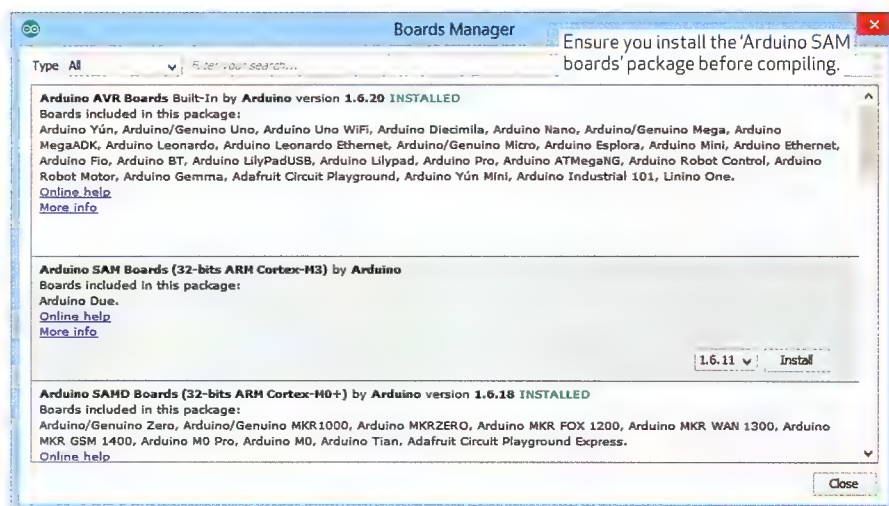
But these tweaks only solve half the problem – with only 20KB of RAM, we still need to code the process of capturing audio samples at 44.1kHz and storing them to microSD card. Of these two tasks – sampling audio and storing the samples – sampling the audio is the most critical. If we don't sample at exactly every 22.67 microseconds, the sampled audio will be all over the shop when we play it back. This is why we use the timer triggered interrupt we mentioned earlier – by hook or by crook, when that interrupt goes off, audio samples will be taken. However, it only takes



around 29 clock cycles to capture those samples, leaving us with around 1,600 clock cycles of free 'downtime' before the next sample must be taken. So we use this 'downtime' to write the samples to the microSD card.

To give us even more leeway, we use a special technique called a 'ring buffer'. We create two arrays from RAM, each capable of storing 3,072 samples (we'd love more, but that's all 20KB of RAM will allow us, after accounting for our code's other needs). Keeping in mind we need to store two samples at each point, one for each channel, 3,072 samples is approximately 34.8 milliseconds of storage, so while one buffer is recording the current samples, the other buffer is being written to the microSD card. Provided that buffer is written to the card in less than 34.8 milliseconds, the system runs smoothly. However, if it takes longer, we'll suffer 'buffer overrun', where the current buffer fills but the next buffer isn't free because it's still waiting for the card to finishing writing. The result sounds like brief 'chirping' on the audio.

Now 34.8 milliseconds isn't very long and it's made worse by having to use SPI transfer rather than the much faster SDIO. Throw in the fact that microSD cards have different write-delay or 'latency' times and you might wonder how the whole thing works at all. However, it does – but in our experience, you need a fast, low-latency microSD card to remove



the buffer overruns. We've had excellent results with a 16GB Sandisk Ultra microSD cards – you'll find these for around \$12.

BUILDING THE RECORDER

We've built our digital audio recorder on a 400-point breadboard. Use the overlay diagram as a guide. The key components are the STM32F103C8T6 'blue pill' board, the microSD card reader module, the AMS1117 3.3VDC regulator module, two-pin pushbutton switch and the 3.5mm TRRS socket module, all available from eBay.

PROGRAMMING THE MCU BOARD

Normally with Arduino boards,

you plug them into your PC via the USB port, select the COM port in the Arduino IDE and away you go. Not here – the STM32F103 boards are not standard Arduino-issue, so we have a few things we need to do. First, you'll need to also purchase an ST-Link V2 module – this does the job of translating 'USB' between the Arduino IDE and the STM32 chip. These cost about \$4 on eBay. It'll come with a number of connecting wires that link between the back of the ST-Link module and the four pin headers on the opposite end of the MCU board to the USB port. Our programming wiring diagram above will help you get the connections

right (only one GND and 3.3V connection is required).

SETTING UP LIBRARIES

The other problem is the Arduino IDE has no idea what the STM32F103 chip is, again, since it's not standard Arduino issue. To fix that, first launch the Arduino IDE (get it from www.arduino.cc/downloads) and from the main menu, select Tools, choose Board from the drop-down menu and 'Boards Manager'. From the list, click on 'Arduino SAM boards (32-bit ARM Cortex-M3)' and install it. This gives us the basic 32-bit compiler to turn our source code into code the chip can use. After that, you need to grab the Arduino STM32 board library, created by Roger Clark, an Australian software engineer, from the GitHub page at tinyurl.com/ybpwbwn (zip file). Unzip the file and copy the folder to \my documents\arduino\hardware. If that path doesn't exist, make it. Now reboot the IDE. This folder contains all the necessary code for the IDE to understand how to code the STM32F103.

Now, there's just one more library to install – and that's the 'SdFat' library that handles the file allocation table (FAT) format of the microSD card (hint: you must format your microSD card in FAT format for this to work). Launch the Arduino IDE and from the menu, select 'Sketch > Include Library > Manage Libraries'. When the Libraries Manager appears, wait for it to update, then in the search bar, type "sdfat". Click on 'SdFat by Bill Greiman', select version '1.0.3' and press the Install button (later versions don't work with our code).

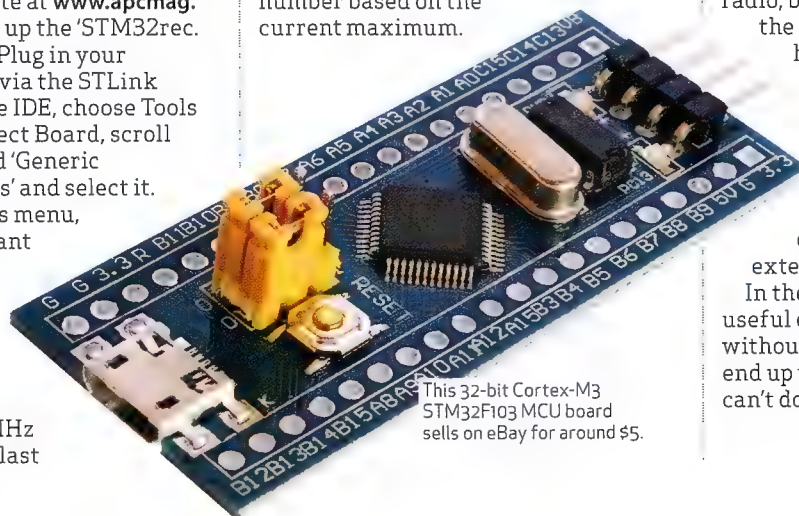
Once it's installed, head to the \my documents\arduino\libraries\sdfat\src subfolder and open up the 'sdfatconfig.h' file in any text editor. Scroll down until you find '#define ENABLE_EXTENDED_TRANSFER_CLASS 0' and change the '0' to a '1'. Save the file.

The last thing you'll need to make this work is our source code – you'll find it on our website at www.apcmag.com/magstuff. Open up the 'STM32rec.ino' file in the IDE. Plug in your STM32F103 board via the STLink module, then on the IDE, choose Tools from the menu, select Board, scroll down until you find 'Generic STM32F103C series' and select it. Go back to the Tools menu, come down to Variant and select the '20k RAM, 64K flash' option. Once again, select the Tools menu and ensure the clock speed is set to '72MHz (normal)'. Now one last

time, choose the Tools menu and set the 'Upload Method' option to 'STLink'. Press the right-arrow Upload button and the source code will be compiled and uploaded via the STLink module to the STM32 board.

USING THE DIGITAL RECORDER

To keep things simple(!), this project has no playback, it just records. It also only has one button. When you power up the first time, if no recognised FAT-formatted microSD card is in the module, the on-board red LED will continuously slow-flash. Press the board's reset button to restart. If it recognises a FAT-ready card, it'll flash twice and go out. When you're ready, press the button, the LED will again blink twice and recording will begin. When you're ready to stop, press the button again and you'll see a series of fast LED flashes. When the LED goes out, remove the microSD card, load it into your PC or notebook's card reader, double-click on the 'rec0.wav' file and it'll begin playing (every media player worth its code handles WAV files). Our source code generates the required WAV file header, automatically incrementing the file number based on the current maximum.



This 32-bit Cortex-M3 STM32F103 MCU board sells on eBay for around \$5.



The ST-LINK v2 module includes jumper wires to connect to the STM32 board.

ADJUSTING SAMPLE RATES

Look in the source code and you'll see a code line where you can set the sample rate. If you find you're getting buffer overrun chirps in your audio output, try dropping the sample rate down – most players support a range of sample rates below 44.1kHz. Start with '32000', then try '24000', '22050' and '16000', but note, the lower the sample rate, the lower the quality.

DRAWBACKS OF READY-MADE BOARDS

Purists will scoff at 12-bit audio, but the fact is it works. However, the popular 'blue pill' board we've used here does have an issue. To minimise digital noise on the ADC inputs, most MCUs provide the ADC with separate power supply lines. The STM32F103C8T6 has these, called 'VDDA' (+) and 'VSSA' (0V), however, these are tied to the digital power lines on this board and together with the lack of shielding on our breadboard layout, allow digital noise from the microSD card writing process to leak into the audio. In theory, 12-bit sampling should give you 72dB dynamic range, or better than FM radio, but because of the digital noise, the signal-to-noise ratio (SNR)

here is nearer 45dB. You won't likely notice it on heavy rock music, but softer passages of classical music won't sound great. Shielded audio cable to the ADC inputs may help a little, but the better option would be a dedicated external ADC chip.

In the meantime, this has been a useful exercise in how to improvise without the right features and still end up with something most phones can't do – record stereo sound. ■

Machine Learning 101: Decision trees and forests

They're the workhorses of classification in machine learning. Darren Yates explains how decision trees and forests make predictions and discover knowledge.

Machine learning might seem one of those tech fields at the moment that has its hype knob wound up to 11, but that's only because there's seemingly no end to what it's being applied to. Everything from property investment to saving indigenous languages is on the receiving end of this melting pot of computer science, maths and statistics we call 'machine learning'. Last time, we introduced the concept of classification, how machine learning can find hidden patterns within data and predict the class of future 'unseen' instances. We introduced the learning method called 'decision trees' and how they are a classic form of classification. This month, we delve deeper and look at not just how a decision tree works, but also at its popular offshoot called 'ensemble learning'.

QUICK RECAP

Classification is a form of machine learning that analyses a training dataset, which often is just a spreadsheet, where each row is a separate but similar event or 'instance' and each column represents a feature or 'attribute' of that instance. The last attribute is called the 'class attribute', for it indicates the category or 'class' the instance belongs to. For example, a car dealership may keep track of customers who want to test drive a new car. Each customer is an instance/row in the spreadsheet and the columns represent attributes of the customers – for example, it could include their address (just suburb or postcode), their salary range (under \$50,000, \$50k to \$75k and so on), their age, sex and finally, the class attribute would be whether or not they purchased a car (yes or no). Using classification in general and a decision tree algorithm in particular, the aim would be to learn from the data the factors that determine which customers are more likely to buy a car after a test drive.

HELLO DATA

It's an unwritten law that the first

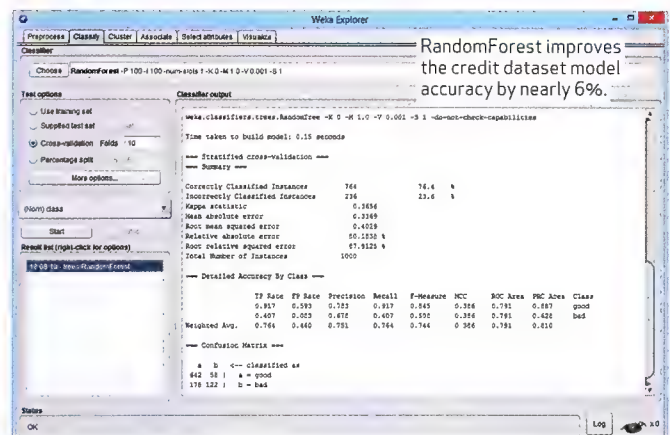
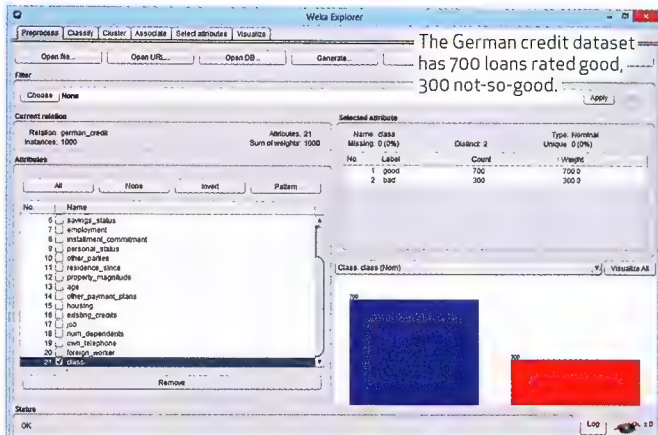


thing you must code in any new language is to print "hello world" to the console or output screen. If machine learning has an equivalent, it's hacking around with the 'Iris' dataset. This dataset dates back to the mid-1930s and has been popular ever since. It contains 150 samples or instances of Iris flower, broken into three groups, 50 of each, representing three species, Iris virginica, Iris versicolor and Iris setosa. Each instance contains five attributes – petal length, petal width, sepal length, sepal width and flower type or 'class'. The petal is the main colourful part of the flower and the sepal, the outer husk or wrapping,

The four measurement attributes are numeric and the class attribute has one of three values to match the flower type – virginica, versicolor or setosa. What we want to do is see if there is a way to accurately predict the flower type just from the petal and sepal dimensions of observed examples.

THE DECISION TREE

Last issue, we talked about classification being a two-step process – first, learning the pattern or 'model' from the training dataset, then second, using the model to predict the class attribute value of a new previously-unseen instance.



Grab the latest version of the Weka data-mining suite for your PC platform from www.cs.waikato.ac.nz/~ml/weka/downloading.html. If you don't have Java, we'd suggest the 'weka-3-8-2jre-x64.exe' version for Windows users. Install it, launch the 'Weka 3.8' shortcut and when the 'Weka GUI Chooser' appears, select 'Explorer' from the right-side menu list.

After the Weka Explorer panel appears, ensure the 'Preprocess' tab is selected and press the 'Open file...' button. Select the 'data' subfolder in your Weka install folder (typically under '/Program files/Weka-3-8' and select 'iris.arff'. Click the 'open' button.

LEARN THE MODEL

Now click on the Classify tab, select the Choose button and from the drop-down context menu, select the Trees option and choose J48. Ensure, the radio-button next to 'cross validation' in the 'test options' group area is selected and the Folds entry reads '10'. Press the Start button. As we mentioned previously, J48 is Weka's version of the C4.5 algorithm and within a millisecond or two, the

cross-validated accuracy result of the learned model appears in the 'Classifier Output' window. You should see the learned model correctly classifies 144 out of the 150 instances, for a 96% accuracy rating. That tells us how good the model is, but not what it actually looks like. In the 'results list' panel on the bottom-left, right-click on the 'trees.j48' entry and select 'Visualize tree' – what you now see is the actual decision tree based on the learned model.

HOW THE DECISION TREE WORKS

There are many types of decision tree algorithm – we're looking at C4.5 here, but others such as CART are also incredibly popular. Nevertheless, the tree structure from each algorithm works in the same way and although most experts like to consider them as a flowchart, it's just as easy to think of decision trees as a roadmap. If you drive to work, your journey is actually a series of decisions. Each road junction is a decision on which path you take – turn left or right, or go straight ahead. What's more, each decision leads to a new decision that progresses you

further along a specific path to your destination. A decision tree is very much like this – but instead of turning left or right, the 'directions' for our decision tree here are set by the instance's attribute values.

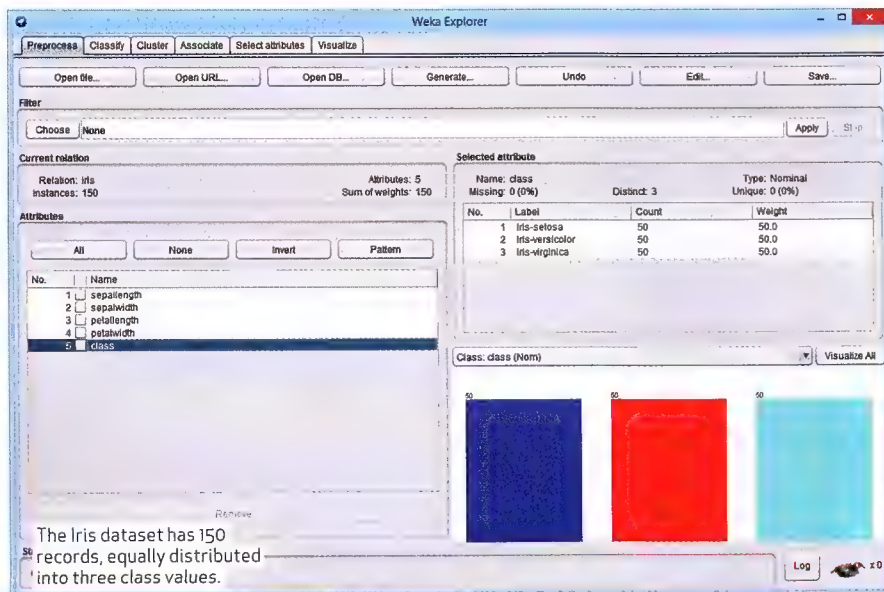
Looking at the decision tree model diagram, it's made up of three parts – each oval or 'node' represents an attribute test, lines dropping down from the node are the possible results from each test and the boxes are the 'leaf nodes' that hold the possible class value options we want to obtain.

Imagine we receive a new Iris record or instance that has no class attribute value – in other words, we don't know what type of Iris flower it is. The record looks like this:

```
{sepal.length=6.5;
sepal.width=3.4;
petal.length=5.9;
petal.width=1.7; class=?}
```

Now that we have our decision tree model, we can use it to predict the class value for this record. Looking at the tree, we start at the top with the 'petal width' attribute, which in our new record, has a value of '1.7'. This is greater than 0.6, so we take the right branch. This takes us to the next node, which is again the 'petal width' attribute, however, this time, the test is whether or not it's less than/equal to or greater than 1.7. Since our record value of 1.7 equals the test value, we now take the left-branch and head to 'petal length'. Our record value here is '5.9', which is greater than 4.9, so again, we take the right branch and come up against another 'petal width' attribute test. Since the record's value for this attribute of 1.7 is greater than the 1.5 test value, we take the right-branch again, but this time end up at the leaf node 'iris-versicolor'.

So based on our decision tree roadmap, we travel down the tree and end up at the leaf 'iris-versicolor', which becomes the class value predicted. Given the 96% classification accuracy noted before, we'd be



reasonably confident this is the correct result.

DECISION TREE ADVANTAGES

One reason why decision trees are popular is that provided you can follow a map, you can easily find your way through a decision tree. What's more – and this is important – you don't need to be a domain expert to decipher the learning. I can tell a gum tree from grass, but that's about it, yet I can now tell you with 96% accuracy how to determine the type of Iris flower from its petal dimensions alone thanks to our decision tree model.

DECISION TREE DRAWBACKS

However, a decision tree can only ever reproduce one map – it may be a great map that accurately predicts the class value of a large percentage of instances in your training dataset under cross-validation testing, but it's still just one map. Chances are, it won't catch every instance. This is where the idea of 'ensemble learning' and decision forests came about – if one tree can't cover every instance, why not have many trees? Conveniently, multiple decision trees become a decision 'forest', part of a field known as 'ensemble learning'.

ENSEMBLE LEARNING

Again, just as you'll find many decision tree algorithms, there are as many, if not more, ensemble learning methods. To keep things simple, there are three key points to remember about ensemble learning and decision forests in particular.

First, these methods build multiple trees or 'base classifiers'. The technique for finding the class of a new instance is pretty similar to what we did before with the decision tree, except this time, we test the new instance against every tree 'map' and record the predicted class value from every tree. Let's say we used a particular ensemble method to generate 100 trees and we put our new instance through all 100 trees. We

tally up the results and 73 trees say the class is 'iris-versicolor', 21 trees say 'iris-setosa' and six 'iris-virginica'.

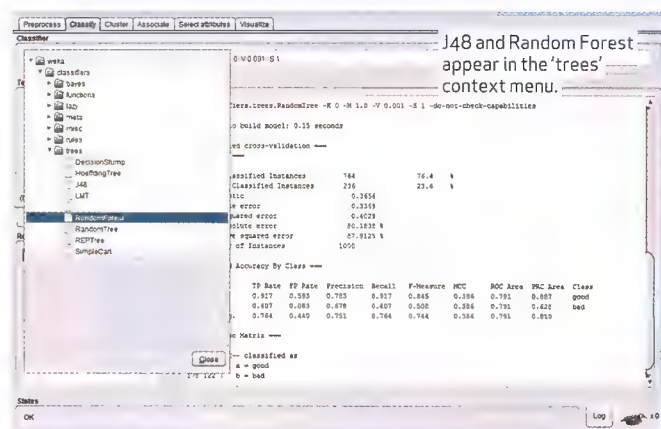
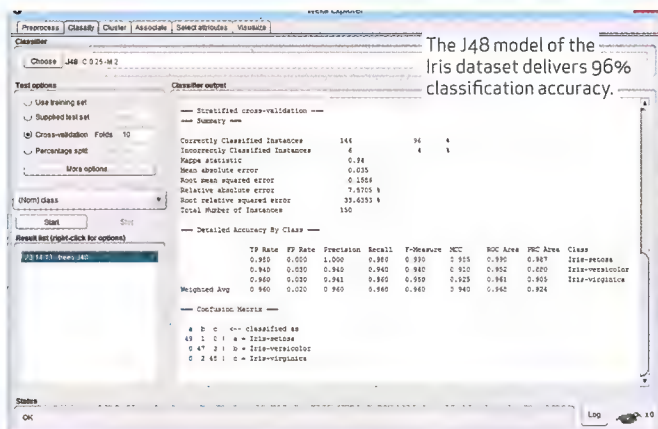
The second point is that the overall class is selected by 'voting'. In this case, since 73 of 100 trees (73%) say 'iris-versicolor', we can decide this becomes the class attribute value for that instance. Not surprisingly, this method is called 'majority voting'. Again, there are multiple voting methods – in this one, every tree has equal weighting, but other voting techniques may weight the votes from trees, giving more credence to the vote of some trees over others. These are collectively called 'weighted voting'.

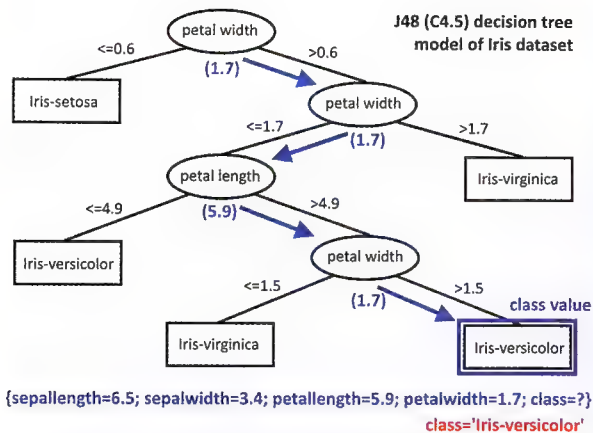
Third, it's important the ensemble trees or classifiers are diverse, that

they vary in their attributes and values forming the tests. Why is this important? On a simple level, if the trees are all the same, you're going to get the same answer from every tree. It'd be like employing ten people who only ever give you the same answer. Why not just employ one and save the wages? Seriously, it's through tree diversity that you are more likely to discover other models that may tell you about a subgroup of instances the first decision tree model doesn't pick up. Ultimately, the aim is greater classification accuracy. Through multiple diverse trees, you're likely to learn more patterns in your data.

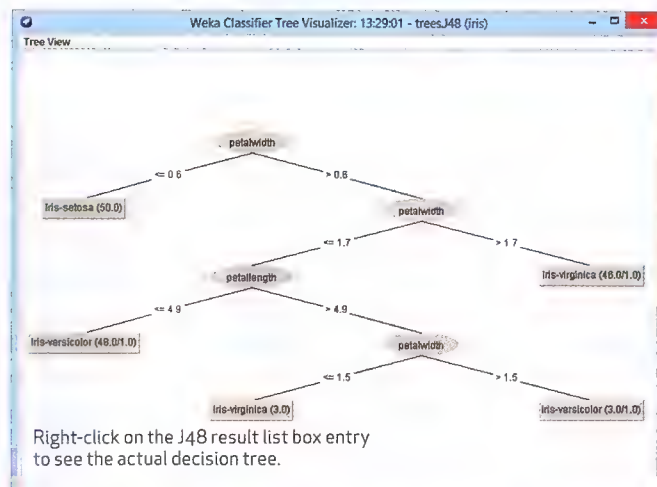


Iris versicolor
(D. Gordon E. Robertson, CC BY-SA 3.0)





Decision trees use a record's attribute values as a road map to find its class.



EXAMPLE

Click on the Preprocess tab on Weka Explorer, press the 'Open file...' button, choose the 'credit-g.arff' file from the 'data' subfolder and click the Open button. We've mentioned a couple of times the example task of determining whether or not a customer loan application represents a good or bad risk, now we're going to try it ourselves. This 'credit-g' training dataset contains 1,000 records based on data from German loan customers. Each record has 20 attributes covering the customer's details from existing credit history, current savings, loan purpose and so on.

Click on the Classify tab, then the Choose button, select the Trees entry from the context menu and choose J48 as before. Tap Start, and within a second or so, it'll come back with a model displaying cross-validated classification accuracy of 70.5%. It doesn't seem too bad, but look at the 'confusion matrix' and you'll see the model correctly picks 117 bad loans as 'bad', but decides 183 bad loans are 'good'. Imagine an antivirus app deciding 183 pieces of malware weren't malware at all – that won't end well.

Go back to the Choose button and this time select 'Random Forest'. Press the Start button. Random Forest is a type of ensemble learning that in its default form here creates 100 trees with varying levels of diversity. Using those 100 trees, the overall classification accuracy has now risen to 76.4%, an improvement of nearly 6%.

However, look back to the 'confusion matrix' and of those 300 bad loans, the 'recall' – the proportion of bad loans predicted as 'bad' – has risen only slightly from 0.39 to 0.407 (122/300). Overall, both models learned are good at picking good loans, but struggle at predicting bad loans, an issue that could cost the



financial institution providing the loans. Nevertheless, Random Forest does improve the result here, thanks to its multiple trees.

ENSEMBLE METHOD DRAWBACKS

Ensemble methods are incredible useful and as popular as decision trees. However, the fact of having multiple trees – sometimes up to several hundred or more – means the algorithm complexity is greatly increased and the knowledge learned is harder to grasp.

If you take nothing else away from reading this, know that there's no such thing as the perfect machine-learning algorithm. If you're interested in machine learning, chances are you've heard the term 'deep learning', which essentially involves different forms

of 'neural networks', a type of machine learning that mimics the brain. In the right context, neural networks are great, but, because of their structure, it can be extremely difficult to glean knowledge about what the neural network has actually learned. In the context of 'supervised learning', we have here where your training dataset instances are already classified, existing techniques like decision trees and ensemble learning methods are often more appropriate.

Next time, we shift up a gear into the world of 'R'. See you then. ■

downtime

» CARMEL SEALEY LEVELS UP AND HEADS ONLINE TO FIND OUT THE LATEST IN GAMING NEWS



Sony kills off physical game cards for PlayStation Vita

NEW GAMES WILL CONTINUE TO BE RELEASED VIA DOWNLOAD.

It seems as though the PlayStation Vita has run its race, with Sony announcing that it will end the production of the console's GameCards "by close of fiscal year 2018". Released back in 2012, the hand-held console struggled to gain a significant foothold following the rise of smartphone gaming. Combined with expensive memory cards and support from Sony, the Vita had a troubled life, but while it looks to be coming to an end, it maintains a strong following in Japan's RPG community.

XCOM 2 mod adds thousands of lines from Red Dwarf

LISTEN TO RED DWARF. WE HAVE IN OUR MINDS A COMPLETE SMUG-POT!

XCOM 2 is a turn-based strategy game in which the player is tasked with issuing commands to squad members in fights against aliens. Featuring lines gleaned from all 12 series of the cult sci-fi comedy series, Red9's Red Dwarf Voice Pack is definitely one of the more interesting mods we've seen released for the game. With clips from Lister, Rimmer, Cat, Kryten and Holly already available, Red9 says he's also going to add Kochanski and the female Holly to the list. Well, smoke us a kipper...!



AMD's FreeSync is finally coming to your lounge room TV

Console gamers get a little lovin'.

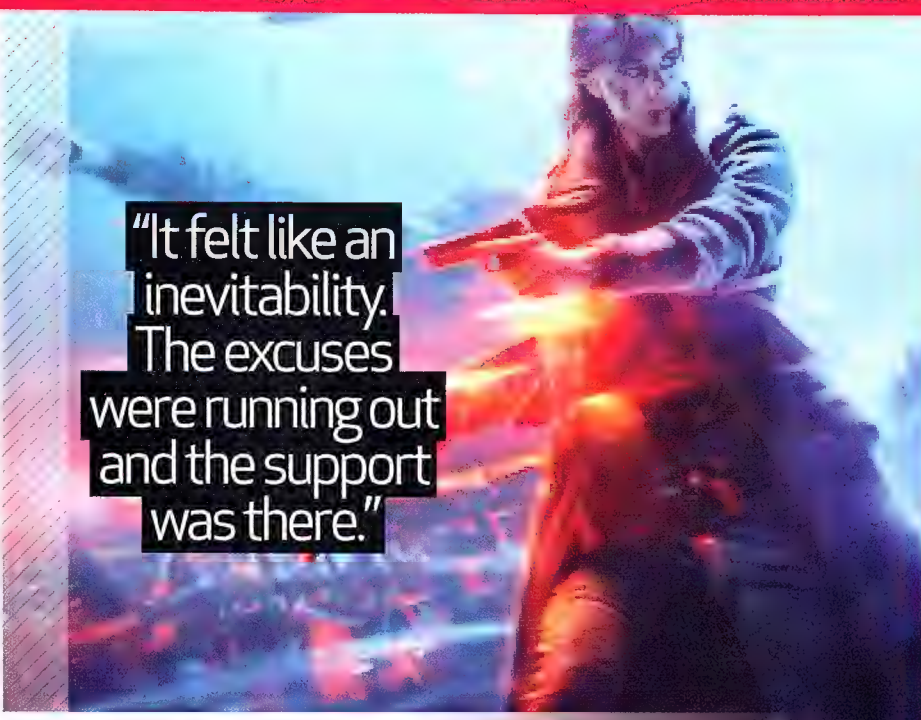
There's something of an arms race between Nvidia and AMD to provide smooth frame rates to your living room, with FreeSync soon to become available on a bunch of Samsung QLED TVs following the announcement of an AMD-Samsung partnership. Earlier this year, Nvidia made its G-Sync available to some of its hardware partners, so it's only natural that AMD would seek to play the catch-up game.

"With Samsung's FreeSync technology QLED TVs, extra smooth gameplay visuals have never been so accessible, and never in such a large and appealing format," announced the Vice President and General Manager of AMD's Radeon Technologies Group, Scott Herkelman. At Computex this year, ASUS announced two new gaming monitors — one for PC gaming, and one destined for the living room (the 4K 31.5-inch CG32UQ), both with FreeSync capabilities. With G-Sync and FreeSync technologies both long-term friends of the PC gaming crowd, it's great to see them entering the lounge room space at last.

NBN chief blames gamers for speed issues

AND THEN CLAIMS THAT HE DIDN'T.

At the start of June, CEO of NBN Co Bill Morrow blamed "gamers predominantly" when he was questioned by a parliamentary committee about usage spikes and congestion on the fixed wireless service during peak times. Due to this, the company is supposedly considering capping the speeds or data of these "extreme users" during those peak hours. Perhaps due to the public outcry over these claims — or perhaps NBN had a look at some of the articles on its own website (namely the ones that show that it's high-def video streaming rather than gaming that rakes in the data) — NBN Co has now come out in defence of its CEO, clarifying that Morrow didn't blame gamers after all. What he had reportedly meant was that it would be "gamers predominantly" who would be most affected by the throttling that could take place in response to the congestion. In other words, while he may not be blaming the gamers, they're likely going to be the ones targeted anyway, for being supposedly "heavy users". Our advice to gamers out there not wanting their usage to be "shaped" during peak periods? Download all your major files outside of the peak hours and then game on as usual!



"It felt like an inevitability. The excuses were running out and the support was there."

Battlefield 5's female playable character is a "sign of things to come", says EA
And she's "here to stay".

The presence of a kick-arse female soldier in the *Battlefield 5* reveal (plus box art) in May this year sparked controversy, unsurprisingly. While many (male) gamers have voiced their anger based on "historical inaccuracy" – women weren't allowed to go to war unless they were nurses or secretaries, so a game purporting realism shouldn't contain any women wielding guns (or cricket bats wrapped in barbed wire) – developer DICE's general manager Oskar Gabrielson came out strongly in defence of their decision to include the character.

On Twitter, Gabrielson declared that "female playable characters are here to stay" and that the team wants to "give players choice to choose ... the characters they play with". While also punching holes in the 'realism' argument, one of the design directors, Alan Kertz, noted: "It felt like an inevitability. The excuses were running out and the support was there... so it happens now." Of course, these statements aren't going to please all the hot-headed history-preserving shitposters out there, but it might just entice new players to the series, which can only be a good thing for the franchise and the gaming community as a whole.

New App Store rule sheds light on Steam streaming app ban

NO STORES WITHIN THE STORE, SAYS APPLE.

Valve has been attempting to get the Steam Link iOS app on to the App Store for quite some time now, but the Steam game streaming app was recently rejected for a second time by Apple, with the Cupertino company citing "business conflicts with app guidelines" as the reason for the latest rejection. While this 'explanation' from Apple has some scratching their heads — not least of which because the Android version is already available on the Google Play store — a recent announcement from Apple may shed some light as to its reasons for rejecting the iOS app.

According to new review guidelines, no app that contains anything that looks like a storefront itself or allows users to "browse, select or purchase software not already owned or licensed by the user" can appear on the App Store. In other words, because the Steam Link would only be mirrored on the iPad or other Apple device, but actually powered by a desktop PC, this means purchases that occur would be outside Apple's control and, therefore, they would miss out on their cut of the purchase price.

'Gaming Disorder' is now officially a thing

JUST ANOTHER ADDICTED RUN.

According to the World Health Organization (WHO), video gaming addiction is now a diagnosable mental health condition. Some of the symptoms include a lack of control over gaming frequency and duration, as well as increasing priorities to gaming over other activities and ignoring the negative side effects of gaming sessions. The organisation interestingly lists online and offline gaming as separate disorders, demonstrating an understanding into the different social (or anti-social) aspects of each. Dr Vladimir Poznyak from the WHO's Department of Mental Health and Substance Abuse states that patients would have to exhibit negative impacts like "disturbed sleep patterns, diet problems [and] a deficiency in ... physical activity" for at least a year before a diagnosis would be made. (Although, we doubt it would take that long for some people we know...!)

The medical world isn't completely on board with this decision yet, with some health professionals citing the benefits of gaming in combatting depression and anxiety, as well as highlighting the beneficial social experiences gamers can experience online. Either way, if you or someone you know may be experiencing problems with excessive gaming, your first port of call should be beyond blue (www.beyondblue.org.au), Lifeline (www.lifeline.org.au) or your family and friends. ■



Seeing the story from three different viewpoints means the 'right' choice isn't always clear-cut.

PS4 | \$79 | WWW.QUANTICDREAM.COM

Detroit: Become Human

This cinematic adventure sets out to push your buttons.

The advent of the android has given the failing city of Detroit the kiss of life. Now a hub of robotic manufacturing, the city is reliving its glory years. You'll be pleased that there's nothing jerky or pixelated about this game's visual presentation. The actors' visages are well-realised digitally and, for the most part, their performances shine through their polygonal forms. Jesse Williams and Bryan Dechart play equally compelling sides of the same android rebellion

coin, playing the leader of the deviant androids and a robot detective who wants to eliminate deviants, respectively. While there is a level of uncanniness to each of the three leads' performances, it is subtle and, as you'd expect, the characters' humanity is pulled to the fore in Valorie Curry and Williams' performances. In contrast, Dechart's Connor is wonderfully stoic and inhuman.

The UI mimics the androids' OS overlay, and your choices throughout are largely well communicated.

This gimmick is used to great effect when justifying the confines of an area, with the android protagonists unable to explore beyond the bounds of a scene as they cannot stray from carrying out their orders.

But alongside this polished presentation is what feels like a first-draft script. The game obviously has a lot on its mind about what it means to be human, the rights of those existing outside of a widely held but woefully narrow definition, and the violence that is perpetrated against them. It's angling for something profound, but the game's exploration of these ideas feels half-baked.

The few quieter moments we do get are some of the most effective. Clawing your way out of an android graveyard or attempting to avoid raising the suspicions of a copper over coffee are both sequences that achieve

a lot more in terms of mood and tension than the louder set-pieces. The conclusion to each android's personal story too is far more satisfying in its execution than the overarching narrative that unites them.

Detroit is a beautiful game that pushes the graphical limits of PS4. As a choice-driven narrative game, it offers a high level of replayability through its many branching scenes. However, what it concerns those scenes with is a great deal of sensation and only lip service to the loftier themes it professes to really be all about.

■ Jess Kinghorn

Verdict

Held together by beautifully chromed nuts and bolts, but with questionable lines of code.



It's down to you just how the deviant androids rebel and what their message is to humanity.





PC, PS4, X0, SWITCH | FROM \$69.95 | WWW.BATTLECHASERS.COM

Battle Chasers: Nightwar

A defunct comic series gets a second chance as a videogame.

With a terrible name that's reminiscent of the hundreds of free mobile roleplaying games that choke up the iOS and Android app stores, it'd be easy to overlook *Battle Chasers: Nightwar* — but fans of fantasy RPGs really shouldn't skip this one, as it's a well-executed and entertaining title using elements that are uncommon these days.

Nightwar serves as a continuation of the *Battle Chasers* comic series, which was both born and fizzled out in the late 1990s after just nine issues — creator Joe Madureira seemingly struggled to keep up with the demands of both writing and pencilling every issue. Over 15 years later, he's managed to return to the fantasy universe he created — now with experience as a videogame developer, having been instrumental in the creation of the cult-classic *Darksiders* games at THQ.

Battle Chasers is designed to play like a Japanese RPG, just with a far more straightforward Western storyline told through



comic-style art. You'll spend your time discovering new locations across the game's overworld map, delving into *Diablo*-like 'exploration' areas (which includes the game's eight main dungeons) and using a variety of abilities and attacks in side-on *Final Fantasy*-style turn-based battles — which are the game's main draw. Those battles are well balanced and challenging enough to provide a meaty bit of fun, with new powers unlocking as your characters level up and harder enemies demanding that you adjust your strategies as you go. Like most JRPGs, it has a fair few different systems to

master, but they're rolled out gradually enough that they're never too intimidating.

While the JRPG gameplay formula may not be particularly original, the execution and quality of the ingredients here is hard to fault. If you're a fan of turn-based RPGs, don't let this one pass you by.

■ Dan Gardiner

Verdict

A well-executed JRPG homage that's hopefully the first in a new series.



Northgard

Looks like a Viking-themed Age of Empires but is so much more.

PC | US\$30

WWW.NORTHGARD.NET

This Viking saga builds on the RTS romps of the '90s, but it's not beholden to them. The basics are familiar. You start with a town hall and some villagers, and grow it into a settlement that can handle raids from monsters and other Vikings. That's done by finding resources and exploiting them using workers and buildings. You know the drill.

As each new layer, from weather to warfare, is introduced, it slows things down so you can take a moment to set priorities, whether that's making pals or scouting the area. But despite the measured pace, winter's approach means there's always some tension. Winter can be overcome by worker placement and preparation. Workers can be switched on the fly, so if a warband is just sitting around, you can make all of them farmers, fishermen or hunters to help keep everyone fed.

Fame is *Northgard*'s most unusual resource. It's a representation of a clan's great deeds, like killing a wyvern or defeating another player, and unlocks bonuses.

The campaign serves as a solid introduction, but the game lives in the skirmish mode. When all of the game's concepts collide, it becomes a tricky, unpredictable real-time strategy that really tests you. ■ Fraser Brown





N++

One of the best platformers of all time goes handheld.

SWITCH | \$29.95
METANETSOFTWARE.COM

Although it has previously released for PC, PS4 and Xbox One, the release of *N++* on Nintendo Switch nonetheless feels like an event. After all, this is one of the best modern platformers available, and Switch is arguably the best platform for this genre.

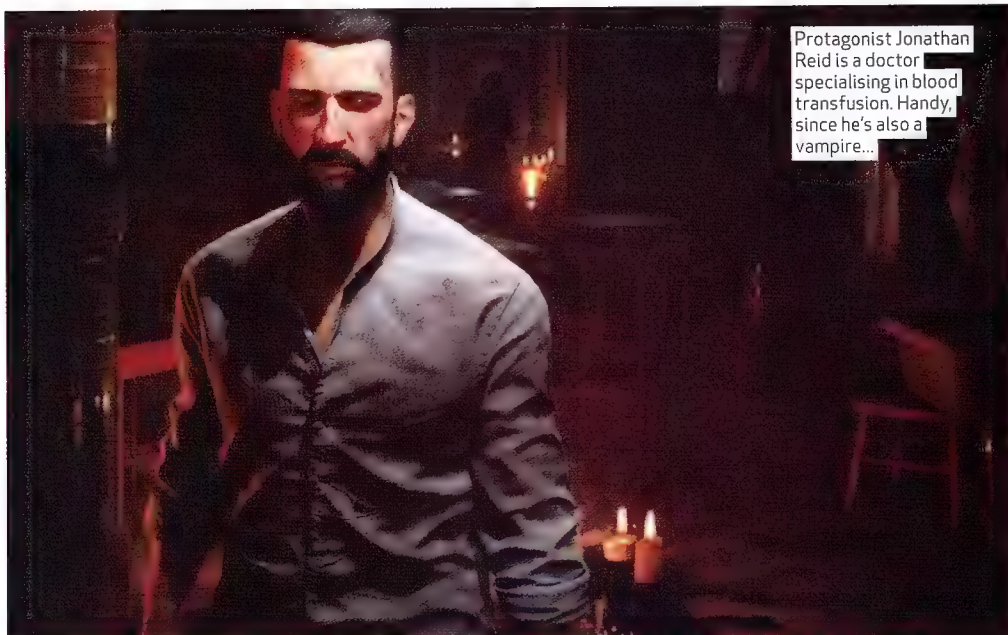
Across well over 6,000 levels, Metanet's signature momentum-oriented platforming feels right at home in a portable format, and the ability to tackle these punishing-yet-addictive gauntlets in short bursts on public transport (or admit it: on the toilet) will likely win over folk too impatient to surmount these challenges in front of a TV or monitor.

There's a lot of game to be played here, and in all likelihood, most players won't survive to play everything that's available: and yet, even chewing through the easier levels should keep more casual players busy for upwards of ten hours.

There's also a whole separate level format for local cooperative play, exhaustive global leaderboards, and the ability to view replays of each and all of the entries on these leaderboards.

N++ is such a beautiful game, that it lends itself to spectator sport, so whether you're watching or playing, this is a game that should be considered essential for the Switch.

■ Shaun Prescott



Protagonist Jonathan Reid is a doctor specialising in blood transfusion. Handy, since he's also a vampire...

PC, PS4, XO | \$89.95 | WWW.VAMPYR-GAME.COM

Vampyr

A slightly ropey but pleasantly ambitious vampire RPG.

RPGs are very much the mainstream in 2018: so it's weird that there's very little experimentation among blockbuster devs in terms of setting: we're normally delivered fantasy RPGs (*The Witcher 3*), sci-fi RPGs (*Mass Effect*) or post-apocalyptic RPGs (*Fallout*). Those archetypes seem to have a stranglehold on the genre.

Which makes *Vampyr* interesting right out of the gate: set in interwar London, the player is cast as Jonathan Reid, a renown doctor who specialises in blood transfusions. The problem is, Reid is a vampire: he thirsts for blood, and his means of acquiring it forms the central novelty of this RPG. Throughout the semi-open-world regions of London, he'll travel, NPCs both significant and otherwise will be available to murder for their rich red lucre. Deciding who to spare and who to murder will determine the outcome of the game's ending.

Vampyr is split between its conversation trees and its combat – it's through the former that you'll decide who to spare and who to drink from, and speaking to



Ranged combat is possible, but getting in close always proves more effective.

everyone thoroughly helps open up branches in other conversation trees. Learning more about characters, and treating them for minor illnesses will increase their blood level. The better quality blood a character has, the more XP you'll acquire from murdering them. While it's possible to play the game without murdering anyone (or at least, murdering very few), doing so will prove difficult as the XP earned feeds into the skill tree and, thus, the game's combat system.

Which, unfortunately, is the weakpoint of this game. It's functionally OK, using the stamina management approach popularised in the *Dark Souls* games, but it's not

quite fluid enough to enjoy for its own sake. We plodded through combat in order to get to what we believed was the real pleasure of the game: the world building and the NPC interactions. These kinds of shortcomings may prove a dealbreaker for some, but it's worth persevering in order to experience one of the moodiest and unique action RPGs to come out of late.

■ Shaun Prescott

Verdict

It's a little rough around the edges, but *Vampyr* is an ambitious and unique action RPG.





PC, PS4, XO | \$50 | WWW.THE-PILLARS-OF-THE-EARTH-GAME.COM

The Pillars of the Earth

Mediaeval England comes beautifully to life in this understated point-and-click adventure.

Adventure games tend to hinge on a specific theme or gimmick, and that's what makes this game so refreshing. It's about ordinary people, with a rich setting based on a fascinating and rarely explored period of history. It's not as immediately thrilling as some, but it has one of the deepest, most mature stories we've ever encountered.

Based on the novel by Ken Follett, the game is set in 12th century England, telling the story of the village of Kingsbridge over a number of years. War, poverty and corruption are rife in this period, and we see three very different lives unexpectedly intertwined by the turmoil of the era. Split into three episodes, the story hops between these different points of view.

One of the most striking things about the game is how atmospheric it is. The painted backgrounds are wonderfully detailed, bringing snowy forests, rolling farmland, grand cathedrals and bustling cities to life. Artful use of

light and shadow, and subtle moving details such as gently falling snow and flickering candles, give the world a vivid sense of place. Mediaeval England was not a pleasant place, but there's beauty in the bleakness. The characters are just as well realised, with nuanced animation and expressive sprites relaying a lot of personality.

The sound design is also fantastic and the voice acting is superb, which is a good thing as you spend much of the game in conversation with people, choosing how to respond and shaping their opinion of you. A timer ticks down as a character awaits a response, giving arguments and other fraught encounters extra tension. We also like how Philip, a monk, can respond to people by reading from the Bible, defusing situations by quoting scripture.

Like many narrative games, the larger story follows a prescribed path. But you can dramatically alter your relationships with people, and steer other events along the way. And at the end of each chapter, you

get a summary of your decisions, which is worth taking a screenshot of to remind yourself, because there are a lot of small, seemingly innocuous choices that can resurface later on.

While *Pillars* is indeed a point-and-click adventure, anyone expecting something heavily puzzle-focused will be disappointed. There are some simple environmental puzzles, and a few rare quick-time events, but story and dialogue take precedence. This suits the game's grounded, realistic tone, however.

While it deals with war, religion and politics, and uses real history to flesh out its setting, the characters keep the story grounded and relatable. Although it will be a hard sell for some, the slow pace is worth persevering with if you value storytelling. **■ Andy Kelly**

Verdict

A beautiful mediaeval adventure that uses history and interesting characters to tell a compelling story.



Donkey Kong Country: Tropical Freeze

A challenging 2D platformer best played with friends.

SWITCH | \$79.95
WWW.NINTENDO.COM

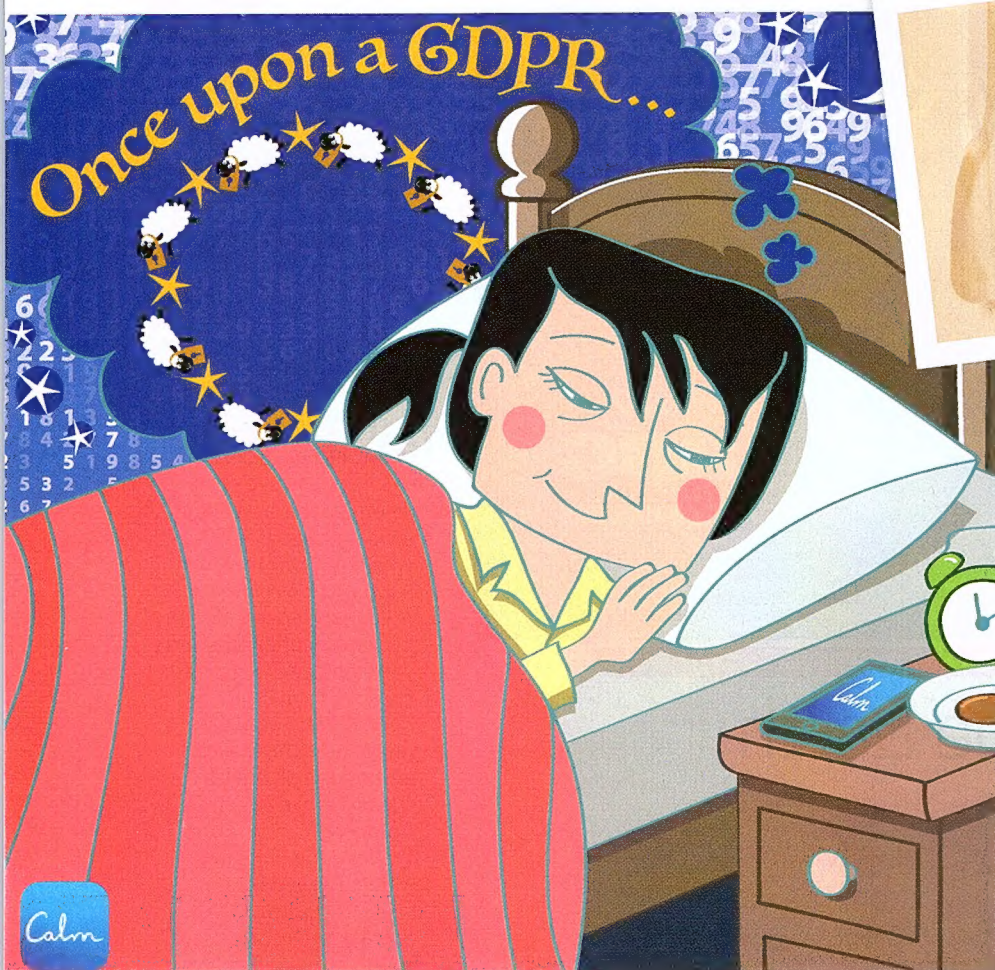
As one of the crowning jewels in the Wii U catalogue, *Donkey Kong Country: Tropical Freeze* risked turning into a buried cult phenomenon with the demise of that console. Thankfully, it's been given a new lease on life with this Switch edition, which brings the game over mostly untouched aside from the addition of Funky Mode. This is a blessing, since it adds a much more forgiving approach to this rather difficult platformer. And don't let the lush 2.5D Nintendo graphics fool you: *Tropical Freeze* is a tough game, even if you opt to ignore all the challenges and hidden collectibles.

Donkey Kong is accompanied by a cast of familiar friends who all modify his moveset in subtle ways. For example, Cranky Kong has a Shovel Knight-esque blade bounce, while Diddy Kong adds a short burst glide.

The game supports local cooperative play, showcasing the versatility of the Switch's detachable Joycons in such a way that it doesn't feel like you're at a disadvantage playing on such a small input device. The Switch is bulging with top quality platformers (*Celeste*, *Super Meat Boy*, *Kirby*), and this should join your personal library.

■ Shaun Prescott





GDPR law is the perfect cure for insomnia

Counting sheep is so yesterday...

As an unwilling member of the insomniac crowd, we're always on the lookout for a tried-and-true method to help us get to sleep and to stay there for the right amount of time. Well, Calm, an online blog dedicated to the promotion of better mental health activities and breathing exercises, has developed a unique solution: turning EU legislation into an audio sleeping aid. The EU's new General Data Protection Regulation (GDPR) is a 209-page document that, according to the blog, is a perfect "bedtime story for grown-ups" (read: it's boring as bat shit). Calm's series *Sleep Stories* now features 'Once Upon a GDPR', a lengthy reading of the legislation by renowned radio announcer Peter Jefferson of BBC's Shipping Forecast fame (aka Britain's 'unofficial national lullaby'). It's quite the liste— Zzz.

Dedicated lanes for smartphone users

CHINESE CITY AIMS TO PROTECT ITS DISTRACTED CITIZENS.

The Darwin Awards are peppered with mobile phone-related incidents, most of which involve users attempting to take selfies with deadly consequences. In an effort to stop people with their eyes glued to their smartphone screens from walking out into traffic or simply bumping into people and causing general annoyance, the Chinese city of Xi'an is introducing a lane for pedestrians who just can't tear their eyes away from their devices. While it's only 100m long and 80cm wide, this safe space might just stop some accidents from happening, so that's definitely a good thing. What it says about the state of humanity, however, is another thing entirely.



Image cred: Harald Doornbo

Possibly-trojaned USB fans given out by North Korea for Trump/Kim summit

PLUG IN AT YOUR OWN RISK.

As the eyes of the world were all fixed upon the historic summit between Donald Trump and Kim Jong Un that took place in Singapore in June, security experts were more concerned with the freebies the North Koreans gifted the attending journalists at the event. The goodie bag, which included a bottle of water, guide to Sentosa and a giant picture of the North Korean leader, also featured a USB-powered handheld fan. North Korea has developed a reputation around the world for being responsible for multiple hacking incidents, making many wary that these fans would allow malicious software to infiltrate journalists' devices and cause havoc.

Telstra outage unknowingly allows criminals with tracking bracelets some free, unmonitored time

FREEEEEEDOOOOOM!

While telecommunications outages normally instigate much ire among the majority of us, the Telstra ones that occurred on the 4th and 21st of May had an unexpected upside for a small number of Australians — those endowed with electronic ankle trackers. These devices are used to keep an eye on naughty Aussies out on parole or bail, making sure they don't go where they're not allowed or attempt to flee the country and the cold, hard grip of justice. A spokesperson from the NT Correctional Services told the *NT News* that, during the 4th May outage, "approximately 85 electronic monitoring devices [had] unresolved communication issues" over the four days it took to resolve the situation. However, offenders apparently would not have been aware of the temporary blind spot in the system, and to seemingly back up this claim, no incidents were reported during that time. Lucky escape, Telstra. It's not the best time to be a telco in this country, is it? ■

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- Intel® Skylake-S LGA1151 (i3/5/7)
- Up to 16GB DDR3L 1600MHz
- mSATA SSD – 2.5" Hard Drive Bay
- Windows® 7 / 8 / 10 / Linux Compatible

DreamBook Ultra Slim N13

- 8th Generation Intel® Core™ i5-8250U Processor
- 13.3" Full HD (1920x1080; 16:9) Display
- 8GB RAM; 500GB HDD Storage
- WiFi; 2 x USB 3.0; Thunderbolt
- Windows® 10 Home

DreamBook 2-in-1 Laptop/Tablet S13

- 8th Generation Intel® Core™ i5-8250U Processor
- 13.3" HD (1920*1080 IPS) LED Multi-Touch Display
- Windows® 10 Professional
- Weight: 1.1kg
- 5.0M Camera

Intel
8th
Generation

8GB
RAM

500GB
SSD

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NVIDIA GTX
1060M
6GB

16GB
RAM

1xPCIe
1xSSD

\$2795



NVIDIA GTX
1080M
2X 8GB SLI

32GB
RAM

2xPCIe
2xSSD

\$6169



DreamBook Style N75

- 8th Generation Intel® Core™ i5-8250U Processor
- Microsoft Cortana with Voice Technology
- 15.6" Full HD (1980x1020; 16:9) Display
- 8GB RAM; 500GB SSD Storage; 2.2kg
- Windows® 10 Home

DreamBook Power P95 VR

- 7th Generation Intel® Core™ i7-7700HQ Processor
- 15.6" Full HD (1920x1080; 16:9) Display
- NVIDIA® GeForce® GTX 1060M 6GB GDDR5
- 16GB RAM; 1TB SSD Storage; 2MP Full HD Camera
- Windows® 10 Professional

DreamBook Power P87 VR SLI

- 8th Generation Intel® Core™ i7-8700 Processor
- 17.3" Full HD (1980x1020; 16:9) Display
- NVIDIA® GeForce® GTX 1080M 8GB GDDR5X (SLI)
- 32GB RAM; 1TB SSD Storage; 2MP Full HD Camera
- Windows® 10 Professional

6 X
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RAM

4TB
STORAGE



NVIDIA GTX
1050Ti
4GB

8GB
RAM

1TB
STORAGE

\$1598



INTEL
XEON-D
Processor

8GB
RAM

16X
HOTSWAP

\$3699



DreamMicro CryptoCurrency Mining HPC DreamVision All-in-One PC J27

- 8th Generation Intel® Core™ i7-8700K Processor
- 8GB Dual Channel DDR4 2133MHz/2400MH RAM
- 120Gb SSD Hard Drive Storage
- 6 x Graphics Cards
- Intelligent fan system

- 7th Generation Intel® Core™ i5-7400 Processor
- 27" Full HD (1920x1080; 16:9) Frameless Display
- NVIDIA® GeForce® GTX 1050Ti 4GB GDDR5
- 8GB RAM; 1TB HDD Storage; WiFi + Bluetooth
- Windows® 10 Home

DreamMicro Power Server 1U SD1Q-1ULH

- Fully customisable to your requirements
- Intel XEON-D D-1541 Processor (6 Core, 2.2GHz)
- 8GB DDR4 RAM (128GB maximum)
- 1TB HDD Storage (16x Hotswap & 2x SSD + RAID)
- Windows® 7/10 or Server 2012 (optional)

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